

IMPACT OF THE CORONAVIRUS PANDEMIC (COVID-19) ON MOOD DISORDERS AND SUICIDE

EDITED BY: Paul Stokes, Carlo Lai, Paola Aceto, Roger McIntyre and
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PUBLISHED IN: Frontiers in Psychiatry





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ISSN 1664-8714

ISBN 978-2-88974-539-5

DOI 10.3389/978-2-88974-539-5

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IMPACT OF THE CORONAVIRUS PANDEMIC (COVID-19) ON MOOD DISORDERS AND SUICIDE

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Citation: Stokes, P., Lai, C., Aceto, P., McIntyre, R., Porter, R., eds. (2022). Impact of the Coronavirus Pandemic (COVID-19) on Mood Disorders and Suicide. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-88974-539-5

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Editorial: Impact of the Coronavirus Pandemic (COVID-19) on Mood Disorders and Suicide

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Keywords: COVID-19, pandemic, mood disorders, suicide, mental health

Editorial on the Research Topic

Impact of the Coronavirus Pandemic (COVID-19) on Mood Disorders and Suicide

The unpredicted spread of the Coronavirus (COVID-19) led to a global crisis that radically changed our lives. After nearly 2 years of the pandemic, the COVID-19 still represents a significant threat to individual and global safety. The governments have adopted necessary restrictive measures to contain the infection and reduce the impact of the crisis on healthcare systems worldwide, forcing people to socially distance and isolate. For this reason, the global outbreak still has important repercussion not only on the physical health: psychological well-being has been severely impacted considering that during the pandemic period the risk of the mental disorder onset also increased.

The 40 papers brought together in this Research Topic provide information about the overall effects of the COVID-19 outbreak on mood disorders and their behavioral consequences. The studies focused on the main risk factors associated with the development of depression, anxiety, and suicidal ideation in different countries and populations (e.g., healthcare workers, students, and people with specific clinical conditions). Moreover, the Research Topic highlights current challenges to cope with the psychological impact of COVID-19, providing insight for the clinical practice to support healthcare professionals, patients with COVID-19, and their relatives.

One of the main consequences of the COVID-19 was the growing prevalence of the depression and anxiety symptoms, which seemed to be higher than the one reported during previous pandemic events, as well as the outbreak of SARS (1, 2), MERS (3), and Ebola (4) (Gong et al.), across the globe. The study of Han et al., conducted in China, showed greater severity of depression when compared with a pre-pandemic period. These findings are consistent with the data related to Australia (Dawel et al.), Wales (Gray et al.), Italy (Bussone et al.), Libya (Elhadi et al.), United States (Rodriguez-Seijas et al.), and Arabia (Khoshaim et al.). Moreover, the impact of COVID-19 influenced sleep quality, as reported by several studies that found an alarmingly high prevalence of insomnia [(5), Bacaro et al.].

A relevant issue was the risk of suicide, as reported by a recent meta-analysis which reported increased event rates for suicidal ideation, suicide attempts, and self-harm during the COVID-19 pandemic (6). It is relevant to consider that the pandemic was not related exclusively to a greater risk of the overmentioned symptoms, but it had an important role in the worsening of the psychological state of people with pre-existing psychiatric conditions and other medical diseases (e.g., bipolar disorders, tourette syndrome, multiple sclerosis, and postpartum depression) (Carmassi et al.; Conte et al.; Donisi et al.; Gobbi et al.; Spinola et al.). In fact, the management of other diseases was affected by the reduction of health system resources which were used to cope with the pandemic crisis.

OPEN ACCESS

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equally to this work

Specialty section:

This article was submitted to
Mood Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 30 December 2021

Accepted: 06 January 2022

Published: 28 January 2022

Citation:

Ciacchella C, Campedelli V,
Veneziani G, Pellicano GR,
Sambucini D and Lai C (2022)
Editorial: Impact of the Coronavirus
Pandemic (COVID-19) on Mood
Disorders and Suicide.
Front. Psychiatry 13:846112.
doi: 10.3389/fpsy.2022.846112

Considering the prevalence of the presented clinical conditions, several risk factors have been investigated. The forced isolation, caused by the strict measures adopted to contain the spread of coronavirus, had transformed day-to-day life, reduced social interactions, and increased fear and anxiety about COVID-19. The adverse effects of the sudden lockdown were particularly evident in the younger generation (Khoshaim et al.; Saravanan et al.). Indeed, the prevalence of symptoms of anxiety and sleep problems was high in university students who experienced uncertainty about their future due to the unpredictable course of the pandemic (Wang et al.). The lockdown was associated with increased feelings of loneliness and poor perceived social support, which seemed to play an important role in the development of depressive and anxious symptoms, increasing the risk of suicidal ideation (Boursier et al.; Cheung et al.; Hoffart et al.; Raj et al.; Velotti et al.). Rumination and COVID-19 related fear could lead to negative affect (Bachem et al.) and could increase feelings of loneliness (Hoffart et al.). Potentially, the relationship between solitude and poor mental health might be mediated by emotion regulation strategies (Velotti et al.), considering that the distance from significant relationships could result in emotional regulation difficulties (Mariani et al.). In this regard, family support plays an important role in reducing the negative impact of lockdown and loneliness, acting as a protective factor against stress (Mariani et al.). Social interactions were carried out with social media and virtual communities to cope with loneliness and negative emotions, providing a slight relief from distress (7). However, the frequency of mobile phone dependence in college students and adolescents was higher than before [(8); Muzi et al.]. It must be pointed out that the excessive use of social media, prolonged in time and forced by the pandemic situation, was associated with increased levels of anxiety (Boursier et al.). Otherwise, staying physically active would attenuate the side effects of COVID-19 on mental health, reducing the risk of the onset of depression and anxiety (Hu et al.).

Another important factor that affected mental health during the outbreak was the employment status, as observed by Mojtahedi et al. Indeed, people who lost their jobs during the pandemic showed higher levels of negative affective states (Mojtahedi et al.).

The Research Topic highlighted the significant impact of the COVID-19 on the healthcare workers (HCW). The HCW faced intense workloads, more significant distress, and a higher risk of occupational exposure (Jaiswal et al.; Li et al.). This professional category experienced high levels of psychological distress due to the overwhelming working environment and the frequent risk of contact with the virus [(9), He et al.; Sirois and Owens]. Moreover, the worry about transmitting the infection to their relatives (Fageera et al.; Sirois and Owens) contributed to increase the tension and to strengthen the feelings of loss of control. In this context, the nurses in intensive care units (ICU) seemed to be the category affected the most (Li et al.), showing high rates of depression and anxiety (Fageera et al.).

Noteworthy, some “psychological antibodies” have been identified as valuable elements to safeguard the mental health of HWC, such as life satisfaction and well-being dimensions (personal growth, self-acceptance, and positive relations) (Jaiswal et al.). Furthermore, long professional experience, adequate training, and clear guidelines, information, and protocols for infection control have been found to buffer the psychological impact of the pandemic (Fageera et al.; Sirois and Owens). Additionally, adequate formal or informal support from supervisors and co-workers was important for reducing stress among HCW (Sirois and Owens).

In light of the results gathered from studies on this Research Topic, there is an evident need to plan interventions to prevent anxious and depressive symptomatology and mitigate the negative psychosocial consequences of COVID-19 (Ge et al.) by improving emotional regulation skills and reducing isolation from family (Mariani et al.). In this regard, Kong et al. showed the effectiveness of a psychological-behavioral intervention in patients with COVID-19. Frequent communication with medical staff and the psychological support provided to hospitalized patients seemed to alleviate the anxiety and fear caused by the virus (Kong et al.). Moreover, the appraisals related to COVID-19 may play a vital role in the psychological well-being of infected patients. Therefore, supporting the readjustment to society among COVID-19 patients is relevant and must be considered when promoting mental health recovery (Chen et al.).

Finally, Bachem et al. underlined the pivotal role of the institutions in an individual's mental well-being during a situation as a pandemic, where being supported by the authorities is an important source of psychological relief. Therefore, special attention should be paid to strengthening trust in the institutions, as this can alleviate the negative impacts of COVID-19 related fears (Bachem et al.).

In conclusion, the pandemic crisis is still ongoing, and uncertainty about the future could worsen people's mental health. New restrictive measures could be periodically imposed, fostering further feelings of loneliness, and exacerbating psychological disorders. In addition, new challenges are opening up related to the emotional burden management, socio-economic crisis, and vaccination. Thus, it is important to plan psychological intervention strategies that can help the general population to cope with the emergency, as well as to address the specific needs of young adults, health care workers, and patients with medical diseases.

AUTHOR CONTRIBUTIONS

CL, CC, VC, and GV wrote the editorial. CL, GP, and DS conceived the editorial and supervised the work. All authors read, performed critical revision, and approved the final version of the editorial.

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The Effect of COVID-19 on Mental Health and Wellbeing in a Representative Sample of Australian Adults

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OPEN ACCESS

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 03 July 2020

Accepted: 07 September 2020

Published: 06 October 2020

Citation:

Dawel A, Shou Y, Smithson M,
Cherbuin N, Banfield M, Calear AL,
Farrer LM, Gray D, Gulliver A,
Housen T, McCallum SM,
Morse AR, Murray K, Newman E,
Rodney Harris RM and Batterham PJ
(2020) The Effect of COVID-19 on
Mental Health and Wellbeing
in a Representative Sample
of Australian Adults.
Front. Psychiatry 11:579985.
doi: 10.3389/fpsy.2020.579985

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There is minimal knowledge about the impact of large-scale epidemics on community mental health, particularly during the acute phase. This gap in knowledge means we are critically ill-equipped to support communities as they face the unprecedented COVID-19 pandemic. This study aimed to provide data urgently needed to inform government policy and resource allocation now and in other future crises. The study was the first to survey a representative sample from the Australian population at the early acute phase of the COVID-19 pandemic. Depression, anxiety, and psychological wellbeing were measured with well-validated scales (PHQ-9, GAD-7, WHO-5). Using linear regression, we tested for associations between mental health and exposure to COVID-19, impacts of COVID-19 on work and social functioning, and socio-demographic factors. Depression and anxiety symptoms were substantively elevated relative to usual population data, including for individuals with no existing mental health diagnosis. Exposure to COVID-19 had minimal association with mental health outcomes. Recent exposure to the Australian bushfires was also unrelated to depression and anxiety, although bushfire smoke exposure correlated with reduced psychological wellbeing. In contrast, pandemic-induced impairments in work and social functioning were strongly associated with elevated depression and anxiety symptoms, as well as decreased psychological wellbeing. Financial distress due to the pandemic, rather than job loss *per se*, was also a key correlate of poorer mental health. These findings suggest that minimizing disruption to work and social functioning, and increasing access to mental health services in the community, are important policy goals to minimize pandemic-related impacts on mental health and wellbeing. Innovative and creative strategies are needed to meet these

community needs while continuing to enact vital public health strategies to control the spread of COVID-19.

Keywords: coronavirus, COVID-19, bushfire, mental health, anxiety, depression, financial strain

INTRODUCTION

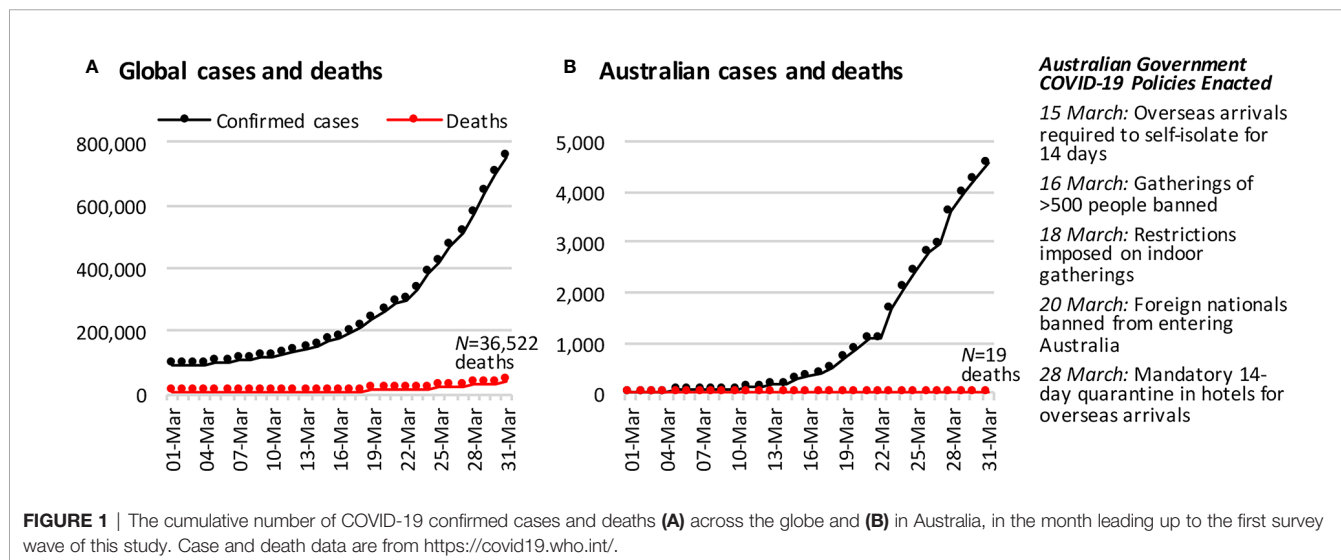
The new coronavirus SARS-CoV-2 (COVID-19) pandemic is unprecedented in recent history, with global impacts including high rates of mortality and morbidity, and loss of income and sustained social isolation for billions of people. The effect this crisis will have on population mental health, both in the short- and long-term, is unknown. There is minimal evidence about the acute phase mental health impacts of large-scale epidemics across communities. Existing work has focused on those individuals most directly affected by disease (e.g., infected individuals and their families, healthcare workers (1–5) and examined mental health impacts across broader communities only after the acute phase has passed (1). In the acute phase however, fear about potential exposure to infection, loss of employment, and financial strain are also likely to increase psychological distress in the broader population (1–4). This distress may be further exacerbated in individuals who have experienced prior traumatic events (2). In the longer term, grief and trauma are likely to emerge (3) and, as financial and social impacts become entrenched, risk of depression and suicidality may increase (2, 6–8).

Reports of the mental health impacts of previous severe health epidemics have focused primarily on disease survivors [e.g., of Ebola virus disease (2) and SARS (1)]. Almost invariably, these studies show survivors experience greater psychological distress post-epidemic than others from affected communities (1, 3). Risk for psychological distress may also be greater for people employed in occupations that potentially expose them to infection (4, 5), and in those who have friends or family members who have been infected (3). However, in the acute

phase of COVID-19, there are clear reasons to also expect that Government policies and physical distancing measures aimed at limiting disease spread will impact mental health in the broader community. For instance, loss of employment (6), financial strain (9), and social isolation (8, 10) are all well-documented correlates of mental health problems. In many countries, physical distancing measures have already resulted in an enormous increase in unemployment (11), likely causing significant financial strain for many.

Gathering early evidence of the impacts of COVID-19 is vital for informing mental health service delivery as the pandemic and its extended effects continue. The present study surveyed a representative sample of Australians from 28 to 31 March 2020, during the acute phase of the pandemic in Australia. **Figure 1** shows the number of confirmed cases in Australia had just started to escalate at this time, relative to global cases. A total of 19 deaths had been reported in Australia by the survey close, relative to over 36,500 across the globe. In the fortnight leading up to the survey, the Australian government had closed restaurants, bars, and churches, severely restricted the size of public and private gatherings, banned foreign nationals from entering Australia, and was enforcing strict quarantine measures for Australians returning from overseas.

The present study aimed to document the initial mental health scenario across the Australian community and examine its association with exposure to the broad COVID-19 environment at this critical acute phase by: (1) measuring the current prevalence of clinically significant symptoms of generalized anxiety and depression, including associations with other recent adversities; and (2) investigating the degree to which symptom severity is associated with exposure to COVID-19, and



pandemic-related impacts on employment, finances, and social functioning. We also accounted for exposure to the catastrophic bushfires that occurred across Australia in November 2019–January 2020. We hypothesized that greater exposure to COVID-19, and impairment in employment, finances, and social functioning, would be associated with higher psychological distress and decreased psychological wellbeing.

METHODS

Study Design and Sample

We established a new longitudinal study—The Australian National COVID-19 Mental Health, Behavior and Risk Communication (COVID-MHBRC) Survey—to investigate the impact of the COVID-19 pandemic on a representative sample of the Australian adult population (≥ 18 years). Participants were required to be able to respond to an online English language survey. The study comprises seven survey waves initiated online fortnightly, *via* Qualtrics Research Services. Recruitment was conducted using quota sampling to obtain a representative sample on the basis of age group, gender, and geographical location (State/Territory). Participants gave written informed consent after receiving a complete description of the study. The study was approved by The Australian National University Human Research Ethics Committee (number 2020/152). The full study protocol is available here: https://psychology.anu.edu.au/files/COVID_MHBRC_protocol.pdf.

We report data ($N = 1,296$) from the first assessment (Wave 1, 28–31 March 2020). The sample size requirement estimate was based on planned power analyses for finding an effect of $f^2 = 0.1$ in linear and logistic regression models, setting $1 - \beta = .95$ and $\alpha = .05$, and taking into account variations in the prevalence of binary outcomes and attrition over the stages of the longitudinal survey, and an allowance for 10% unusable data. Our sample of $N = 1,296$ was only 2% less than our target sample of $N = 1,320$ (see **Supplement S1** for additional details). Only 2–3% of the data were unusable for the present analyses.

Table 1 reports Wave 1 sample distributions by gender, age, and location. These distributions aligned well with population data from the Australian Bureau of Statistics (12), demonstrating that a representative sample of the Australian community was achieved.

Survey Measures

Symptoms of depression and anxiety over the last 2 weeks were assessed by the Patient Health Questionnaire-9 (PHQ-9) (13) and Generalized Anxiety Disorder-7 (GAD-7) (13) respectively. These measures align closely with diagnostic criteria for major depressive disorder and generalized anxiety disorder respectively (14). General psychological wellbeing over the last 2 weeks was measured using the World Health Organization Wellbeing Index (WHO-5) (15).

COVID-19 exposure was computed as the sum of self-reports of possible or actual exposures to the virus, of the related population health response, or of close social impact including:

TABLE 1 | Sample demographics and comparison with population data from the 2016 Australian Census (12).

	Sample <i>n</i>	%	Population %
Gender			
Male	645	49.8	49.3
Female	649	50.2	50.7
Missing	2		
Age			
18–24	163	12.6	10.3
25–34	244	18.8	18.8
35–44	231	17.8	17.6
45–54	223	17.2	17.3
55–64	195	15.0	15.4
65+	240	18.5	20.5
State/Territory			
Australian Capital Territory	37	2.9	1.6
New South Wales	409	31.6	32.2
Northern Territory	12	0.9	1.0
Queensland	249	19.2	20.3
South Australia	96	7.4	7.3
Tasmania	36	2.8	2.3
Victoria	313	24.2	24.9
Western Australia	144	11.1	10.4

having been diagnosed with the virus, awaiting results from a test, having tested negative to the test, being in direct contact with a carrier of the virus, having had to isolate in the past, having chosen to isolate in the past, being currently forced to isolate, currently choosing to isolate, having a family member diagnosed with the virus, having a family member in isolation, knowing someone who was diagnosed, knowing someone in isolation, or being asked to work from home because of the virus.

Our measures of the work and social impacts of COVID-19 were whether someone had lost their job due to COVID-19 (yes/no); was working from home due to COVID-19 (yes/no); was experiencing financial distress due to COVID-19 (six-point Likert-type rating, from Not at all to Extremely); and the overall extent to which their work and social activities were impaired by COVID-19, measured using the Work and Social Adjustment Scale (WSAS) (16). For the WSAS, participants rated the level of impairment COVID-19 had caused (eight-point Likert-type rating, from Not at all impaired to Very severely impaired) for five work and social domains (ability to work, home management, social leisure activities, private leisure activities, and ability to form and maintain close relationships).

We also measured other background factors that could be associated with mental health: age (in years); gender (male/female/other); years of education; partner status (yes/no); living alone (yes/no); living with dependent children (yes/no); existing health, neurological, or psychological conditions, diagnosed by an appropriate clinician (yes/no); recent exposure to bushfire smoke (yes/no) or fire (yes/no); and impact of other recent adverse life events (five-point Likert-type rating, from Not at all to Extremely). Regarding the bushfire exposure variables, our reason for separating out smoke from fire is that many Australians who were exposed to smoke lived far away from the actual fires and their home/region was never under direct threat. The major impact for smoke-but-not-fire affected individuals

was poor air quality, which prohibited people from spending time outside for several weeks over the Summer.

Statistical Analysis

Statistical analyses were conducted in R version 3.6.3 under RStudio version 1.1.456 (17). Multiple linear regression was the primary technique employed to assess correlates of poor mental health. Models were checked and showed an absence of multicollinearity, outliers, and non-normality in the residuals. However, as is typical in non-clinical samples, the PHQ-9 and GAD-7 variables had high frequencies at their lowest possible values, resulting in incorrigible skew. Therefore, compound Poisson-gamma (Tweedie distribution) generalized linear models (18) were estimated as a check on the linear models (Supplement S2). Their results were consistent with the linear models. Likewise, the models included categorical predictors with small subsample sizes, so cross-validation was conducted to ensure that the models were stable (Supplement S3). Overall, <1% of data were missing. Models reported in the main text dealt with these cases using listwise deletion. We also multiply imputed the missing values and reran the models, which produced the same pattern of findings (Supplement S5).

RESULTS

Table 2 presents our sample characteristics. Overall, 20.3 and 16.4 of our sample scored above the clinical cut-offs on our depression (PHQ-9) and anxiety (GAD-7) measures respectively. **Table 3** shows these rates are notably elevated compared to other community-based samples. Even among individuals without a current diagnosis, the rates remained elevated well above levels seen in other representative community-based samples.

Investigation of the relationships between our predictor measures and three mental health outcome measures used a Bonferroni adjusted significance threshold of 0.17 to control for the three sets of comparisons, i.e., $\alpha = .05/3 = .017$. Note, all three measures showed good reliability (see Supplement S6).

Our initial univariate tests revealed that higher levels of depression and anxiety symptoms, and lower psychological wellbeing (WHO-5), were all associated with job loss and financial distress, and overall work and social impairment due to COVID-19, as measured by the WSAS. Being required to work from home was not associated with any mental health effects at this acute stage of the pandemic, all $ps > 0.27$ (see Supplement S6 for all univariate results).

TABLE 2 | Description of sample characteristics, including comparison of men and women.

Sociodemographic and background factors	Whole sample (n = 1,296)		Men (n = 645)		Women (n = 649)		t or χ^2	df	p
Age, M years (SD)	46.0	(17.3)	49.5	(18.2)	42.7	(15.6)	7.17	1293	<.001***
Education, M years (SD)	13.8	(2.6)	13.6	(2.7)	13.9	(2.5)	-1.68	1282	.093
Has partner, n (%)	853	(66.2%)	421	(65.7%)	432	(67.0%)	0.19	1	.665
Lives alone, n (%)	157	(12.1%)	82	(12.7%)	75	(11.6%)	0.30	1	.581
Child at home, n (%)	406	(31.3%)	196	(30.4%)	209	(32.2%)	0.42	1	.519
Any chronic disease, n (%)	503	(38.8%)	286	(44.3%)	217	(33.4%)	15.73	1	<.001***
Any neurological disorder, n (%)	159	(12.3%)	86	(13.3%)	73	(11.3%)	1.12	1	.290
Any mental health disorder, n (%)	310	(23.9%)	144	(22.3%)	165	(25.4%)	1.54	1	.214
Recent adversity									
Bushfire exposure—smoke, n (%)	607	(46.8%)	290	(45.0%)	316	(48.7%)	1.66	1	.198
Bushfire exposure—fire, n (%)	111	(8.6%)	66	(10.2%)	45	(6.9%)	4.08	1	.043*
Other adverse life event, n (%)	282	(21.8%)	156	(24.2%)	126	(19.4%)	4.05	1	.044*
COVID-19 exposure									
COVID-19 exposure, M (SD)	0.78	(0.88)	0.71	(0.82)	0.85	(0.9)	-2.75	1293	.006**
Work and social impacts of COVID-19									
Working from home, n (%)	173	(13.4%)	78	(12.1%)	95	(14.6%)	1.60	1	.206
Lost job, n (%)	117	(9.0%)	50	(7.8%)	67	(10.3%)	2.30	1	.130
Financial distress, n (%)	652	(50.3%)	314	(48.7%)	338	(52.1%)	1.36	1	.243
WSAS, n (SD)	20.5	(9.3)	20.3	(9.8)	20.8	(8.8)	-1.11	1293	.267
Mental health measures									
PHQ-9, score (SD)	5.4	(5.9)	4.7	(5.7)	6.0	(6.0)	-3.93	1290	<.001***
GAD-7, score (SD)	4.4	(5.2)	3.7	(4.9)	5.1	(5.4)	-5.07	1288	<.001***
WHO-5, score (SD)	11.9	(5.9)	12.9	(6.0)	10.9	(5.7)	6.16	1289	<.001***

* $p < .05$; ** $p < .001$; *** $p < .001$.

Bold indicates tests significant at $p < .05$.

TABLE 3 | Prevalence of depression and generalized anxiety based on self-reported current mental health diagnosis.

	Existing current diagnosis (n = 310)		No diagnosis (n = 985)		Total sample (n = 1,295)		Comparison to other population sample studies
Major Depressive Disorder (PHQ-9$\geq$10)	145	(46.8%)	118	(12.0%)	263	(20.3%)	5.6% (19), 6.7% (20)
Generalized Anxiety Disorder (GAD-7$\geq$10)	113	(36.5%)	99	(10.1%)	212	(16.4%)	5.1% (21)

Comparisons samples are general population samples from the USA (19) and Germany (20, 21). To the best of our knowledge, there are no published pre-pandemic norms from the Australian national population for these measures.

The linear regression models, presented in **Table 4**, established that the effects of financial distress and overall work and social impairment were independent, and not better accounted for by demographic or other background factors. Job loss however did not have a significant independent association with mental health after accounting for financial distress and other covariates, all $p > 0.25$.

In contrast, the regression analyses found no significant unique association between exposure to COVID-19 and depression or anxiety symptoms, or wellbeing.

Depression and anxiety symptoms were also elevated in people who had experienced other recent adversities, although this did not include direct exposure to the recent catastrophic Australian bushfires. Exposure to bushfire smoke was however associated with decreased wellbeing.

Finally, within these regression models, we also found that younger age, identifying as female, and having at least one current mental health disorder were each independently associated with higher levels of depression and anxiety, and decreased wellbeing.

DISCUSSION

We found the social, work, and financial disruptions induced by the acute phase of the COVID-19 pandemic were associated with considerable impairments in community mental health in Australian adults. In contrast, exposure to COVID-19 was not found to predict mental health in this cohort. A key strength of

this study was the testing of a representative community sample early in the pandemic, providing rapid evidence of population mental health status. The results highlight that epidemics may cause serious problems for community mental health in the acute phase of disease.

Indeed, our results suggest that, at a population level, changes to social and work functioning due to COVID-19 were more strongly associated with decrements in mental health than amount of disease contact. This finding is consistent with a recent UK-based finding that their citizens were more concerned about how societal changes will impact their psychological and financial wellbeing, than becoming unwell with the virus (7). This finding is also consistent with emergent work indicating that loneliness is playing a central role in the observed mental health impacts of the COVID-19 pandemic (22–24). Altogether then, it is evident that the necessary public health arrangements surrounding the pandemic are having serious implications for community mental health, *via* their disruption to social and work functioning.

However, this does not mean the mental health costs of pandemic-related social changes will inevitably be greater than those caused by exposure to disease. In Australia, mortality rates were very low at the time of this study, and the health system had capacity to meet demand. The relatively low case rates were also reflected in our sample; although the majority of the sample had some exposure, such as needing to self-isolate, only 36 participants reported direct exposure to the virus (self or close contact diagnosed). The short-term mental health impacts of disease contact may be considerably greater in communities that

TABLE 4 | Linear regression models for each mental health outcome.

	PHQ-9 ($n = 1,273$, $df = 16$, 1256)		GAD-7 ($n = 1,270$, $df = 16$, 1253)		WHO-5 ($n = 1,271$, $df = 16$, 1254)	
	estimate	p	estimate	p	estimate	p
Constant	3.73	<.001***	2.36	.012*	12.41	<.001***
Sociodemographic and background factors						
Age	−0.05	<.001***	−0.04	<.001***	0.03	.002**
Gender	0.84	.003**	1.02	<.001***	−1.76	<.001***
Education	−0.10	.055	−0.04	.361	0.14	.022
Has partner	−0.47	.150	0.14	.627	0.60	.106
Lives alone	0.23	.628	−0.14	.739	−0.26	.627
Child at home	−0.28	.359	−0.03	.928	0.53	.126
Any chronic disease	0.64	.052	0.54	.072	−0.83	.026
Any neurological disorder	1.29	.006**	0.42	.320	−0.49	.352
Any current MH disorder	4.65	<.001***	3.92	<.001***	−3.07	<.001***
Recent adversity						
Bushfire exposure—smoke	0.26	.336	0.15	.534	−0.96	.002**
Bushfire exposure—fire	−0.40	.406	−0.48	.282	0.72	.188
Other adverse life event	1.80	<.001***	1.31	<.001***	−0.32	.411
COVID-19 exposure						
COVID-19 exposure	0.24	.129	0.18	.210	0.39	.028
Work and social impacts of COVID-19						
Lost job	0.43	.383	0.51	.255	−0.24	.660
Financial distress	2.32	<.001***	2.10	<.001***	−2.38	<.001***
WSAS	0.09	<.001***	0.06	<.001***	−0.06	.005**
	R^2	Adjusted R^2	R^2	Adjusted R^2	R^2	Adjusted R^2
Model	.369	.361	.322	.314	.208	.198
		F		F		F
		45.91***		38.48***		20.53***

* $p < .017$. ** $p < .001$. *** $p < .001$.

Bold indicates tests significant at $p < .017$.

have high mortality rates, and health systems over-burdened by disease. In the longer-term, disease contact may also lead to elevated levels of trauma and grief for affected individuals (3).

The elevated levels of psychological distress observed in this study indicate mental health services are likely to experience increased demand during pandemics. Following recommended physical distancing guidelines, these will need to be delivered flexibly, leveraging resources for telehealth and internet-based Cognitive Behavior Therapy (CBT) programs, which have been shown to be effective in preventing and treating common mental disorders (7, 25, 26). There may also be an increased role for community cohesion strategies (27) and peer support (28), for instance, drawing on the experience and knowledge of people already living with mental health issues to support those experiencing these issues for the first time.

The findings also provide clear evidence that minimizing social and financial disruption during the COVID-19 pandemic should be a central goal of public health policy. A key challenge is how to best achieve this goal without compromising public safety by, for instance, relaxing physical distancing restrictions too early. Our results suggest policy approaches that target financial support to those experiencing financial strain may be useful, rather than on the basis of lost employment alone. We also found that well-established risk factors for poorer mental health—younger age, identifying as female, and having a pre-existing mental health condition—continue to be associated with increased risk within the pandemic context. Governments should consider additional measures to monitor and support these at-risk groups. Psychosocial interventions to support multiple aspects of wellbeing, including minimizing financial debt, may have positive impacts on depression and anxiety in the community (29). Clinicians should also remain vigilant for potential added social and financial impacts that existing clients in primary care and psychological settings may be experiencing.

A possible limitation of the present study is the use of self-report scales that may not characterize mental health status with the accuracy of structured clinical interviews, although both the PHQ-9 and GAD-7 have previously demonstrated strong alignment with clinical diagnosis in population samples (14), and the WHO-5 is also well-validated (15). Another potential issue is the influence of selection bias on the prevalence of mental health problems seen in this sample, however, the likelihood of this is low. We were careful to ensure the recruitment advertisement did not mention the topic or nature of our survey (e.g., no mention of mental health or COVID-19 at all), and the service we used also recruits participants for non-psychological research (i.e., market research panel). Most importantly, we did obtain a sample that was representative of the Australian population by age, gender, and location. It is however important to note that online survey methods may bias samples towards people who have good internet literacy and access (30). This type of bias may have a disproportionate impact on subsections of the population, such as older adults.

Finally, this initial report of our work is cross-sectional. The observed associations may not reflect causal effects, and the

nature of any causal relationships may be more complicated than our interpretation suggests (e.g., possible bi-directional effects between psychological distress and social/occupational functioning). We intend to balance the necessity of providing our first wave findings in a timely fashion, to rapidly inform ongoing global responses to the pandemic, by reporting longitudinal outcomes as they become available in the coming months. Examination of population subgroups within our sample may also be possible in longitudinal analyses, although additional targeted studies may be required to provide greater insight into how specific vulnerable groups are affected. These findings should also be considered in combination with other studies that survey the mental health impacts of COVID-19 in communities that have adopted different approaches to managing the pandemic and/or have differing social structures (e.g., low GDP) to Australia.

In conclusion, the current study provides a snapshot of the acute phase impact of COVID-19 on the mental health of the Australian adult community. The findings are concerning, suggesting markedly elevated rates of depression and anxiety, even among individuals with no current diagnosis. This worsening of mental health may also have been exacerbated by the recent severe bushfire season Australians had experienced in the months leading up to the pandemic, although bushfire exposure was controlled for in our analyses. Overall, the findings suggest that interventions to counteract the social, financial and role disruptions induced by COVID-19, particularly among people with existing health conditions, are likely to have the greatest impact on community mental health and wellbeing.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Australian National University Human Research Ethics Committee. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors contributed to the design and conceptualization of the study, which was coordinated by AD. AD, PJB, and LMF contributed to the literature review. AD, PJB, YS, MS, and NC contributed to the data analyses and formulation of the manuscript, with input from all other authors. AD, PJB, NC, and MS drafted the manuscript and all authors critically revised the manuscript. All authors contributed to the article and approved the submitted version.

FUNDING

This study was funded by the ANU College of Health and Medicine, ANU Research School of Psychology, and ANU Research School of Population Health. PJB is supported by National Health and Medical Research Council (NHMRC) Fellowship 1158707. ALC is supported by NHMRC Fellowships 1122544 and 1173146. LMF is supported by Australian Research Council Discovery Early Career Researcher Award (ARC DECRA) DE190101382. YS is supported by ARC DECRA DE180100015. AG and ARM are supported by funding provided by the ACT Health Directorate for ACACIA: The ACT Consumer and Carer Mental Health Research Unit.

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ACKNOWLEDGMENTS

We thank Patrice Ford for assistance with preparing this manuscript and Georgia Baines for media monitoring.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2020.579985/full#supplementary-material>

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Corrigendum: The Effect of COVID-19 on Mental Health and Wellbeing in a Representative Sample of Australian Adults

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OPEN ACCESS

Edited and reviewed by:

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 20 October 2020

Accepted: 10 December 2020

Published: 21 January 2021

Citation:

Dawel A, Shou Y, Smithson M, Cherbuin N, Banfield M, Calear AL, Farrer LM, Gray D, Gulliver A, Housen T, McCallum SM, Morse AR, Murray K, Newman E, Rodney Harris RM and Batterham PJ (2021) Corrigendum: The Effect of COVID-19 on Mental Health and Wellbeing in a Representative Sample of Australian Adults. *Front. Psychiatry* 11:619331. doi: 10.3389/fpsy.2020.619331

Keywords: coronavirus, COVID-19, bushfire, mental health, anxiety, depression, financial strain

A Corrigendum on

The Effect of COVID-19 on Mental Health and Wellbeing in a Representative Sample of Australian Adults

by Dawel, A., Shou, Y., Smithson, M., Cherbuin, N., Banfield, M., Calear, A. L., et al. (2020). *Front. Psychiatry* 11:579985. doi: 10.3389/fpsy.2020.579985

In the original article, there was an error in **Table 3** as published. The prevalence of depression and generalized anxiety in our sample appeared in the wrong rows. The main text of the original article did however report the prevalence rates correctly, i.e., the statement “Overall, 20.3% and 16.4% of our sample scored above the clinical cut-offs on our depression (PHQ-9) and anxiety (GAD-7) measures respectively.” (p. 4 of original article) is correct. The corrected **Table 3** appears below.

The authors apologize for this error and state that this does not change the scientific conclusions of the article in any way. The original article has been updated.

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TABLE 3 | Prevalence of depression and generalized anxiety based on self-reported current mental health diagnosis.

	Existing current diagnosis (n = 310)		No diagnosis (n = 985)		Total sample (n = 1,295)		Comparison to other population sample studies
Major Depressive Disorder (PHQ-9≥10)	145	(46.8%)	118	(12.0%)	263	(20.3%)	5.6% (19), 6.7% (20)
Generalized Anxiety Disorder (GAD-7≥10)	113	(36.5%)	99	(10.1%)	212	(16.4%)	5.1% (21)

Comparisons samples are general population samples from the USA (19) and Germany (20, 21). To the best of our knowledge, there are no published pre-pandemic norms from the Australian national population for these measures.



Knowledge, Anxiety, Fear, and Psychological Distress About COVID-19 Among University Students in the United Arab Emirates

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OPEN ACCESS

Edited by:

Carlo Lai,
Sapienza University of Rome, Italy

Reviewed by:

Gaia Romana Pellicano,
Sapienza University of Rome, Italy
Daniela Sambucini,
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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 10 July 2020

Accepted: 14 September 2020

Published: 22 October 2020

Citation:

Saravanan C, Mahmoud I, Elshami W
and Taha MH (2020) Knowledge,
Anxiety, Fear, and Psychological
Distress About COVID-19 Among
University Students in the
United Arab Emirates.
Front. Psychiatry 11:582189.
doi: 10.3389/fpsy.2020.582189

Background: Fear of infection, the epidemic situation, unexpected lockdown, and implementation of online classes are most likely affecting the psychological well-being of students during the COVID-19 pandemic. Therefore, this study aims to assess the level of knowledge, anxiety, and psychological distress concerning COVID-19 and their association with fear, gender, age, history of mental illness, time spent reading about COVID-19, program of study, and type of dwelling among students in the United Arab Emirates (UAE).

Methods and Materials: In this cross-sectional study, 433 students participated in a web-based survey. These were students at the University of Sharjah, coming from all the emirates of the UAE. Demographic scale, COVID-19 knowledge, anxiety, fear, and psychological distress scales were used to screen these problems.

Results: Of the 433 students, 278 (64.2%) were male and 155 (35.8%) were female. Overall, 353 (81.5%) exhibited adequate knowledge of COVID-19. Sixty-nine (15.9%) of students were anxious and 221 (51%) were in psychological distress. Students who exhibited anxiety concerning COVID-19 anxiety (odds ratio [OR]: 2.98) and fear (OR: 1.27), and who spent more than 4 h reading about COVID-19 (OR: 11.20) were more psychologically distressed. Students with a history of mental illness showed adequate knowledge of COVID-19; however, they were more psychologically distressed (OR: 5.93). Older students were less likely to have psychological distress (OR: 0.87).

Conclusion: Students possess adequate knowledge concerning COVID-19; however, they are psychologically distressed. Age, dwelling status, history of mental illness, anxiety, and fear significantly predicted psychological distress. Frequent web-based workshops that include insight, guidance, online counseling, scheduled activity, and coping mechanisms for COVID-19 are highly recommended. The authors discuss the implications for future research and provide recommendations for students and educational institutions.

Keywords: anxiety, fear, COVID-19, distress, knowledge, United Arab Emirates, students

INTRODUCTION

The spread of any infectious disease is associated with anxiety, fear, psychological distress, and other symptoms of mental illness (1, 2). The COVID-19 pandemic is a major health catastrophe, with more than 11,000,000 cases confirmed (3). In the United Arab Emirates (UAE), up until the first week of July 2020, 50,857 cases had been reported (4). The fear of the COVID-19 infection, unexpected lockdown, and sudden implementation of online classes may lead to stress, anxiety, and other emotional problems among students (5, 6). Students need more ways to adjust and adapt to this situation as the lack of coping mechanisms to manage fear and anxiety may lead to significant physical and psychological distress.

Knowledge of COVID-19 and related safety and preventive measures is imperative to prevent disease spread and psychological distress (7, 8). However, students who spend a lot of time reading and watching the news about COVID-19, especially on social media, may get confused and misinterpret the seriousness of COVID-19 (9, 10). A study conducted in the Jordan identified that students have adequate knowledge about COVID-19, but are reluctant to wear face masks (8). These students are more anxious and fearful of infections as they either have insufficient information or misinterpret information about COVID-19. Maarefvand et al. (11) found that knowledge about the prevention of COVID-19 was significantly associated with stress among the public in Iran, but not among the student population. Hence, lack of knowledge and misconceptions about COVID-19 may lead to psychological distress. Past studies have shown that male students exhibited more anxiety and stress (12, 13), whereas another study concluded that there were no significant gender differences in the level of anxiety and stress among the student population (14). It is not necessarily the case that students with medical and health science backgrounds have more knowledge and are less anxious than arts and science students. One study conducted overseas found no significant difference between medical and non-medical students on anxiety and knowledge (7). However, a study conducted in the Middle East showed that medical students have more knowledge about COVID-19 than non-medical students (15). No data is available about anxiety and psychological distress during the COVID-19 outbreak among students with and without a history of mental illness. Therefore, there is a need to study students' knowledge, anxiety, amount of time spent reading about COVID-19, history of mental illness, gender differences, and programs pursued as these relate to psychological distress among students during the COVID-19 pandemic.

Stress is simply the body's response to changes that create taxing demands (16). Psychological distress is an aversive, negative state in which coping and adaptation processes fail to return an organism to physiological and psychological homeostasis (17). A very few studies have identified the prevalence of stress among the student population overseas, but no study was available in the UAE and other Middle Eastern countries. In China, anxiety levels among students were higher than the average (18). In a previous study in the UAE, it was reported that almost half of students experienced anxiety

levels ranging from mild to severe (15). Most of the students were anxious and fearful concerning COVID-19 infection (19). Al-Rabiaaha (20) identified a significant relationship between fear, anxiety, and stress but not psychological distress. In addition, past studies (5, 14) conducted overseas used generalized anxiety scales, depression, anxiety, and stress scales, and fear scales to screen for anxiety, fear, and stress during COVID-19, but these scales can also be used for non-COVID-19-related situations. Scales such as the Coronavirus Anxiety Scale and the Fear of COVID-19 Scale that exclusively measure anxiety and fear related to COVID-19 were not used among the student population. Using these scales to screen for anxiety and fear would most likely provide a more exact picture of COVID-19-related anxiety and fear. In addition, past studies did not measure psychological distress or its association with anxiety and fear. Educational institutions and the Ministry of Health and Prevention in the UAE provide adequate awareness about COVID-19. However, we are not sure of the level of knowledge, fear, and anxiety among students, and the association with psychological distress and no distress.

The University of Sharjah is one of the largest universities in the UAE, with students hailing from all the emirates. Conducting research on students from this university will represent students from other universities as well. Based on the above-mentioned past literature, this study aimed to assess the level of knowledge, anxiety, and psychological distress among students. Further, this study aimed to measure the differences and associations between knowledge, anxiety, psychological distress, and demographic characteristics such as gender, age, history of mental illness, time spent reading about COVID-19, program (course) of study, and type of dwelling place (villa, apartment, and dorm or shared apartment). In addition, this study aimed to measure to what extent lack of knowledge, anxiety, fear, gender, history of mental illness, program (course) of study, time spent reading about COVID-19, age of the participants, and dwelling place predicted the psychological distress caused by COVID-19. The first hypothesis of this study is that there would be a significant association and differences between knowledge, anxiety, fear, psychological distress, and demographic characteristics (age, gender, course, dwelling status, time spent reading about COVID-19, and history of mental illness). The second hypothesis of this study is that demographic characteristics, knowledge, anxiety, and fear are significant predictors for psychological distress.

METHOD

Participants

In this cross-sectional study, 433 students participated in a web-based survey. We collected data from students at the University of Sharjah (UOS) from May 1 to 30, 2020. The demographic information on the participants is shown in **Table 1**.

Sample Size

Based on the sample size calculation, with a 5% margin of error and 95% confidence interval, this study requires a minimum of 377 participants. However, this study expects 10%

TABLE 1 | Demographic characteristics of participants and their levels of knowledge, anxiety, and psychological distress.

Variable	No. (%)
Age, years Mean (SD)	21 (2.9)
Gender	
Male	278 (64.2)
Female	155 (35.8)
College	
Arts	200 (46.2)
Engineering	115 (26.5)
Health science/science	74 (17.1)
Medical	44 (10.2)
Dwelling status	
Villa	251 (58)
Apartment	140 (32.3)
Dorm/shared	42 (9.7)
Time spent reading about COVID-19	
<1 h	290 (67)
1–2 h	91 (21)
3–4 h	25 (5.8)
More than 4 h	27 (6.2)
History of mental illness	
No	363 (83.8)
Yes	70 (16.2)
Knowledge of COVID-19	
Mean (SD)	4.5 (1.2)
Inadequate knowledge	80 (18.5)
Adequate knowledge	353 (81.5)
COVID-19 anxiety	
Mean (SD)	5.4 (3.6)
No	364 (84.1)
Yes	69 (15.9)
Psychological distress	
Mean (SD)	15.8 (6)
No	212 (49)
Yes	221 (51)
COVID-19 fear Mean (SD)	16.6 (6.3)

SD, standard deviation.

of questionnaires to be incomplete, so a minimum of 414 participants are needed.

Procedure

Once the study had received ethical and research approval (REC-20-05-07-01) from the Ethics and Research Committee of the University of Sharjah, we sent an online invitation through the university's official portal to all UOS students. The online invitations highlighted that participation was voluntary, participants could withdraw at any time, and all the information collected would be kept confidential. Online consent was received from all the participants before they completed the questionnaire. Proper contact details were provided on the first page of the survey if participants wanted to clarify their doubts about this

study. The online survey was set up to provide an automatic thank you statement to the students who completed the survey.

Materials

Sociodemographic Scale

A sociodemographic scale was created for this study. The scale measured the participants' gender, course (program of study), age, history of mental illness, and dwelling status (villa, apartment, dorm or shared apartment).

Knowledge About COVID-19

A scale was developed to measure public knowledge about COVID-19. This scale consisted of six items measured on a five-point Likert scale. One point was given for correct answers, and no points were given for incorrect or uncertain answers. Participants with scores four and above were rated "adequate knowledge" and <4 indicated "inadequate knowledge" on COVID-19 (10). The alpha reliability value of this study was 0.79.

Coronavirus Anxiety Scale

The Coronavirus Anxiety Scale was used to measure anxiety about COVID-19. Each item was rated on a five-point Likert scale to reflect the frequency of the symptom, ranging from 0 (not at all) to 4 (nearly every day) over the preceding 2 weeks. Participants who scored nine and above were considered as experiencing COVID-19 anxiety and <9 indicated no COVID-19 anxiety. The reliability of this scale ranges from 81 to 87 (21). The alpha reliability value of this study was 0.88.

Fear of COVID-19 Scale

This scale measured the fear of COVID-19 infection. The participants indicated their level of agreement with statements using a five-item Likert-type scale. The minimum score possible for each question was one, and the maximum was five. The total score was calculated by adding the scores for each item (giving a total ranging from 7 to 35). The higher the score, the greater the fear of COVID-19. Reliability values are $\alpha = 0.82$ for internal consistency and 0.72 on retest and test (22). The alpha reliability value of this study was 0.89.

The Kessler Psychological Distress Scale

The Kessler Psychological Distress Scale (K-6) is a shortened, six-item version of the K-10. This scale was used to measure psychological and non-psychological distress. It measures non-specific psychological distress based on a framework that includes behavioral, emotional, cognitive, and psychophysiological manifestations. In this study, responses were summed to produce a total score ranging from 6 to 30, with higher scores signifying more distress. Participants who scored 16 and above were considered to be experiencing psychological distress and a score of <16 was considered to indicate no psychological distress. Based on the cut-off score on this scale, this study analyzed psychological distress as a categorical variable (psychological distress and no psychological distress) and total score of the psychological distress scale is also considered as a continuous variable in the results. K-6 has been found to be

reliable, with Cronbach's α ranging from 0.89 to 0.92 (23, 24). The alpha reliability value of this study is 0.88.

Statistical Analysis

Frequencies with proportions and means with standard deviations (SD) were reported to describe the characteristics of the study participants and their levels of knowledge, anxiety, psychological distress, and fear.

All variables were analyzed in two ways. First, a chi square test (X^2) was used for the categorical variables (adequate and inadequate knowledge, anxiety and no anxiety, psychological distress, and no psychological distress), as well as for other variables (gender, dwelling status, history of mental illness, and time spent reading about COVID-19) and counts (number) with percentages are presented in the tables. Second, a t -test and analysis of variance (ANOVA) were used for the continuous variables (knowledge, anxiety, fear, and psychological distress) and data presented as means (SD). The fear scale and age were analyzed as continuous variables throughout this study.

The primary outcome, the psychological distress scale, was sorted into two categories based on the cutoff score of the scale, where 16 and above indicated participants experienced psychological distress (Yes) and below 16 indicated participants did not experience psychological distress (No). Variables that were significantly associated with psychological distress in bivariate analyses were included in the multivariate binary logistic regression model. Age and fear were included as continuous variables, and dwelling status, time spent reading about COVID-19, history of mental illness, and anxiety were included as categorical variables in the binary logical regression model.

The Omnibus Tests of Model Coefficients showed that the binary logistic regression models were statistically significant. The case-wise plots were not produced because no outliers were found, and no multicollinearity detected (variance inflation factor < 3). Statistical significance was set at $p \leq 0.05$. The data analyses were performed with the IBM Statistical Package for Social Sciences (SPSS) Statistics for Windows Version 25.0 (25).

RESULTS

Of the 433 study participants, 278 (64.2%) were men. The mean age of the study participants was 21 years (SD $\pm$ 2.9 years, range 18–38 years). **Table 1** shows the characteristics of the study participants.

Prevalence of Knowledge, Anxiety, and Psychological Distress

Table 1 shows that the prevalence of students who were not knowledgeable about COVID-19 was 80 (18.5%) and knowledgeable 353 (81.5%). There were 364 (84.1%) students who showed no anxiety and 69 (15.9%) who showed anxiety. Prevalence among students of no psychological distress was 212 (49%) and psychological distress 221 (51%).

Association and Difference Between Demographic Variables and Knowledge About COVID-19

Table 2 shows that there were no significant differences in the level of knowledge based on age, gender, educational program, and dwelling status ($p > 0.05$). However, participants with a history of mental illness showed a higher level of knowledge than participants without a history of mental illness (92.9 vs. 79.3%, $p = 0.002$). Furthermore, participants with lower levels of fear of COVID-19 had more knowledge than participants with higher levels of fear of COVID-19 (mean 16.3 ± 5.8 vs. 18.1 ± 7.8 , $t = 2.40$, $p = 0.017$).

Association and Difference Between Demographic Variables and COVID-19 Anxiety

Table 3 shows that male participants (18%), living in a dorm or shared apartment (26.2%), who spent more than 4 h reading about COVID-19 (44.4%), with a history of mental illness (35.7%), with psychological distress (27.6%), and more fear of COVID-19 (23 ± 6.9) have higher levels of anxiety than women (12.3%), living in a villa (15%), who spent <1 h reading about COVID-19 (8%), without a history of mental illness (12%), without psychological distress (4%), and less fear of COVID-19 (15.4 ± 5.4), $p \leq 0.05$.

Association and Difference Between Demographic Variables and Psychological Distress

Table 4 shows that participants who are younger (21.1 ± 2.5), living in apartments (59.3%), spend more than 4 h reading about COVID-19 (92.6%), with a history of mental illness (83%), with anxiety (88.4%), and more fear of COVID-19 (19.7 ± 6) have higher levels of psychological distress than older (21.7 ± 3.3) participants, living in villas (45.4%), who spend <1 h reading about COVID-19 (42.8%), without a history of mental illness (45%), without anxiety (44%), and less fear of COVID-19 (13.3 ± 4.7), $p < 0.05$.

Table 5 shows the correlations between knowledge and anxiety ($r = 0.026$, $p = 0.584$), knowledge and fear ($r = -0.098$, $p = 0.043$), knowledge and psychological distress ($r = -0.013$, $p = 0.794$), anxiety and fear ($r = -0.481$, $p < 0.0001$), anxiety and psychological distress ($r = -0.375$, $p < 0.0001$), and fear and psychological distress ($r = -0.494$, $p < 0.0001$).

Predictors of Psychological Distress

Variables that are significantly associated (age, dwelling status, time spent reading about COVID-19, history of mental illness, anxiety, and fear) with psychological distress (**Table 4**) were included in the multivariate binary logistic regression model. **Table 6** demonstrates the multivariate binary logistic regression for the predictors of psychological distress among the study participants. Our regression model explained only 45% of the variability in psychological distress, controlling for age, dwelling status, time spent on reading about COVID-19, history of mental illness, anxiety, and fear. Older participants [odds

TABLE 2 | Association and differences between knowledge and demographic variables, psychological distress, anxiety, fear.

Variable	Knowledge of COVID-19 status						
	χ^2 -test				t-test/ANOVA		
	Inadequate knowledge <i>n</i> (%)	Adequate knowledge <i>n</i> (%)	χ^2	<i>P</i>	M(SD)	t/F	<i>P</i>
*Age, years							
Mean (SD)	21.8 (3.3)	21.3 (2.8)		0.218		1.23	
Gender							
Male	48 (17.3)	230 (82.7)	0.8	0.385	4.6 (1.2)	−1.77	0.077
Female	32 (20.6)	123 (79.4)			4.4 (1.2)		
Educational program							
Arts	38 (19)	162 (81)	2.3	0.522	4.4 (1.2)	1.71	0.165
Engineering	25 (21.7)	90 (78.3)			4.5 (1.1)		
Health sciences/sciences	10 (13.5)	64 (86.5)			4.7 (1.2)		
Medical	7 (15.9)	37 (84.1)			4.8 (1.3)		
Dwelling status							
Villa	42 (16.7)	209 (83.3)	1.5	0.469	4.1 (1.2)	2.77	0.064
Apartment	28 (20)	112 (80)			4.4 (1.1)		
Dorm/shared	10 (23.8)	32 (76.2)			4.2 (1.4)		
Time spend reading about Covid-19							
<1 h	55 (19)	235 (81)	3.2	0.356	4.5 (1.2)	1.81	0.145
1–2 h	12 (13.2)	79 (86.8)			4.7 (1.1)		
3–4 h	6 (24)	19 (76)			4.3 (0.9)		
More than 4 h	7 (25.9)	20 (74.1)			4.3 (1.4)		
History of mental illness							
No	75 (20.7)	288 (79.3)	7.1	0.008	4.4(1.2)	−3.18	0.002
Yes	5 (7.1)	65 (92.9)			4.9 (1)		
COVID-19 anxiety							
No	64 (17.6)	300 (82.4)	1.2	0.271	4.5 (1.2)	1.07	0.285
Yes	16 (23.2)	53 (76.8)			4.4 (1.4)		
Psychological distress							
No	35 (16.5)	177 (83.5)	1.1	0.302	4.6 (1.2)	0.83	0.409
Yes	80 (18.5)	176 (79.6)			4.5 (1.2)		
COVID-19 fear							
Mean (SD)	18.1 (7.8)	16.3 (5.8)		0.017		2.40	

*Analyzed as continuous variable (t-test) only, P-values in bold are statistically significant. M= Mean, SD= standard deviation.

ratios: (OR) 0.87, 95% confidence interval: (CI) 0.80–0.95, $p = 0.002$] are less likely to suffer from psychological distress compared to younger participants. Furthermore, participants who are living in apartments (OR= 2.48, 95% CI: 1.44–4.24, $p = 0.001$), spent more than 4h reading about COVID-19 (OR= 11.20, 95% CI: 2.23–56.24, $p = 0.003$), have a history of mental illness (OR= 5.93, 95% CI: 2.66–13.26, $p < 0.0001$), have anxiety (OR= 2.98, 95% CI: 1.18–7.50, $p < 0.021$), and have more fear of COVID-19 (OR= 1.27, 95% CI: 1.20–1.34, $p < 0.0001$) are more likely to suffer from psychological distress compared to participants living in a villa, who spent <1h reading about COVID-19, without a history of mental illness and anxiety, and who have less fear of COVID-19.

DISCUSSION

In this study, 81.8% of students show adequate knowledge about COVID-19. The prevalence of anxiety is 16% and the psychological distress is 51%. History of mental illness and COVID-19 fear are significantly associated with knowledge, anxiety, and psychological distress. Furthermore, dwelling status and time spent on reading and watching about COVID-19 are associated with anxiety and psychological distress. However, gender and educational program are associated with anxiety only. Living in apartments, spending more than 4h reading and watching about COVID-19, a history of mental illness, and COVID-19 anxiety are significantly predicting psychological distress.

TABLE 3 | Association and differences between anxiety and demographic variables, knowledge, psychological distress, fear.

Variable	COVID-19 anxiety status						
	χ^2 -test				t-test/ANOVA		
	No N (%)	Yes N (%)	χ^2	P	M(SD)	t/F	P
Age, years*							
Mean (SD)	21.8 (3.3)	21.3 (2.8)		0.397		0.85	
Gender							
Male	228 (82)	50 (18)	2.4	0.119	6.3 (3.2)	-7.49	0.0001
Female	136 (87.7)	19 (12.3)			3.8 (3.8)		
Educational program							
Arts	166 (83)	34 (17)	4.8	0.189	5.9 (3.4)	3.27	0.021
Engineering	102 (88.7)	13 (11.3)			4.8 (3.4)		
Health sciences/sciences	63 (85.1)	11 (14.9)			5.5 (4)		
Medical	33 (75)	11 (25)			4.5 (4.3)		
Dwelling status							
Villa	213 (84.9)	38 (15.1)	3.7	0.157	5.7 (3.2)	5.82	0.003
Apartment	120 (85.7)	20 (14.3)			4.6 (3.9)		
Dorm/shared	31 (73.8)	11 (26.2)			6.5 (4.5)		
Time spend reading about COVID-19							
<1 h	267 (92.1)	23 (7.9)	48.5	0.0001	4.5 (3.1)	25.0	0.0001
1–2 h	67 (73.6)	24 (26.4)			6.8 (3.4)		
3–4 h	15 (60)	10 (40)			7.2 (4.9)		
More than 4 h	15 (55.6)	12 (44.4)			9 (4.5)		
History of mental illness							
No	319 (87.9)	44 (12.1)	24.4	0.0001	5.2 (3.5)	-3.37	0.001
Yes	45 (64.3)	25 (35.7)			6.7 (4)		
COVID-19 knowledge							
Inadequate knowledge	64 (80)	16 (20)	1.21	0.270	5.4 (4.4)	-0.15	0.878
Adequate knowledge	300 (85)	53 (15)			5.4 (3.4)		
Psychological distress							
No	204 (96.2)	8 (3.8)	45.9	0.0001	14.9 (5.7)	-7.06	0.0001
Yes	160 (72.4)	61 (27.6)			20.7 (4.9)		
COVID-19 fear*							
Mean (SD)	15.4 (5.4)	23 (6.9)		0.0001		-10.2	

*Analyzed as continuous variable (t-test) only, P-values in bold are statistically significant. M, Mean; SD, standard deviation.

Similar to the present study students in Jordan (7), Iran (19), Italy (26), and the Philippines (9) also expressed adequate knowledge about COVID-19. The study showed that most of the educational institutions had provided adequate information about COVID-19. This could be the reason for students to have adequate knowledge about the mode of transmission of COVID-19 and preventive measures, but some students who are dependent on social media may end up with incorrect information about COVID-19 (8, 27). In this study male students were found to be more knowledgeable than female students. However, a study conducted in Jordan found that females had more knowledge about COVID-19 than males (12). Studies found that students have adequate knowledge about safety measures such as hand sanitizing, avoiding social gatherings,

and mode of transmission of infection, but some students were reluctant to wear masks (8).

Medical students have more knowledge of COVID-19, followed by students in the health sciences, engineering, and arts programs. The result is consistent with another study conducted in the UAE (15). However, a study conducted in Jordan found no significant difference between medical and non-medical students on knowledge about COVID-19 (7). The result of this study is consistent with a study conducted in Russia, which found no significant relationship between knowledge and the amount of time spent on reading and watching about COVID-19 (28). These results show that time spent reading about COVID-19 is not significantly associated with knowledge, but the amount of scientific knowledge students have about COVID-19

TABLE 4 | Association and differences between psychological distress and demographic variables, knowledge, anxiety, fear.

Variable	Psychological distress status						
	χ^2 -test					t-test/ ANOVA	
	No n (%)	Yes n (%)	χ^2	P-value	M(SD)	t/F	P
Age, years*							
Mean (SD)	21.7 (3.3)	21.1 (2.5)		0.019		2.36	
Gender							
Male	134 (48.2)	144 (51.8)	0.2	0.672	16 (6)	−0.55	0.580
Female	78 (50.3)	77 (49.7)			15.6 (5.9)		
Educational program							
Arts	101 (50.5)	99 (49.5)	3.1	0.382	15.6 (6)	1.40	0.332
Engineering	61 (53)	54 (47)			15.3 (5.7)		
Health sciences/sciences	32 (43.2)	42 (56.8)			16.3 (6.1)		
Medical	18 (40.9)	26 (59.1)			17.1 (6.3)		
Dwelling status							
Villa	137 (54.6)	114 (45.4)	7.6	0.022	15.3 (6.1)	2.57	0.053
Apartment	57 (40.7)	83 (59.3)			16.6 (5.6)		
Dorm/shared	18 (42.9)	24 (57.1)			16.6 (6)		
Time spend reading about COVID-19							
<1 h	166 (57.2)	124 (42.8)	36.4	0.0001	14.7 (5.9)	13.54	0.002
1–2 h	39 (42.9)	52 (57.1)			17.1 (5.7)		
3–4 h	5 (20)	20 (80)			18.6 (5)		
More than 4 h	2 (7.4)	25 (92.6)			20.6 (4.4)		
History of mental illness							
No	200 (55.1)	163 (44.9)	33.8	0.0001	15 (5.7)	−6.65	0.0001
Yes	12 (17.1)	58 (82.9)			19.9 (5.5)		
COVID-19 knowledge							
Inadequate knowledge	35 (43.8)	45 (56.3)	1.1	0.302	16.1 (5.3)	0.49	0.626
Adequate knowledge	177 (50.1)	49 (49.9)			15.7 (6.1)		
COVID-19 anxiety							
No	204 (56)	160 (44)	45.9	0.0001	14.9 (5.7)	−7.87	0.0001
Yes	8 (11.6)	61 (88.4)			20.7 (4.5)		
COVID-19 fear*							
Mean (SD)	13.3 (4.7)	19.7 (6)		0.0001		−12.15	

*Analyzed as continuous variable (t-test) only, P-values in bold are statistically significant. M, Mean; SD, standard deviation.

is imperative for the adherence to safety procedures. COVID-19 is an unprecedented situation that requires a great deal of adaptation and assimilation.

The first hypothesis of this study, that participants who have a history of mental illness show adequate knowledge about COVID-19, is fully accepted. However, a study conducted among the public in China found that people with a history of mental illness were prone to complications of COVID-19, due to poor insight and difficulties adhering to safety measures (29, 30). In addition, this study found no significant association between knowledge and psychological distress, and knowledge was not a significant predictor for psychological distress. Past studies had identified that lack of knowledge, fear of infection, and worries about COVID-19 most likely trigger stress (7, 8, 11).

In this study, the prevalence of anxiety was 16%, less than was found in Spain—22.3% (5), China—22.1% (14), Jordan—22.5% (31), and the Kingdom of Saudi Arabia—23% (20).

TABLE 5 | Correlations among knowledge, anxiety, fear and psychological distress.

Variables	1	2	3	4
1 COVID-19 knowledge	—			
2 COVID-19 anxiety	0.026	—		
3 COVID-19 fear	−0.098*	0.481**	—	
4 Psychological distress	−0.013	0.375**	0.494**	—

*Correlation is significant at the 0.05 level; **Correlation is significant at the 0.01 level.

The mean value of this study result is also less than a study conducted in India (32). All the earlier studies had used the Generalized Anxiety Questionnaire to screen for anxiety, but this study used the Coronavirus Anxiety Scale, which exclusively measured anxiety about COVID-19. Students who were anxious

TABLE 6 | Predictors of the psychological distress among study participants.

Variable	OR	95% CI	P-value
Age	0.87	0.80–0.95	0.002
Dwelling status			
Villa	1		
Apartment	2.48	1.44–4.24	0.001
Dorm/shared	1.55	0.65–3.73	0.326
Time spend reading about COVID-19			
<1 h	1		
1–2 h	0.72	0.39–1.32	0.284
3–4 h	1.43	0.41–5.00	0.577
More than 4 h	11.20	2.23–56.24	0.003
History of mental illness			
No	1		
Yes	5.93	2.66–13.26	0.0001
COVID-19 anxiety			
No	1		
Yes	2.98	1.18–7.50	0.021
COVID-19 fear	1.27	1.20–1.34	0.0001

P-values in bold are statistically significant. OR, Odds Ratios; CI, Confidence Interval.

experienced more fear of COVID-19. Only one study measured the fear of COVID-19, and that study used a general fear scale to assess fear during COVID-19 (20), but this study used the COVID-19 Fear Scale, which is exclusively used to measure fear of COVID-19. This result of this study shows less coronavirus anxiety than other studies conducted among the student population overseas. Students are well-informed about the COVID-19 safety and precaution measures in the UAE, which could be another reason for less anxiety found in this study. The result of this study is consistent with the study conducted in China that male students were significantly more anxious than female students (13), but females experienced more anxiety than males in Jordan (31). No gender difference was found in another study conducted in China (14). The differences in gender concerning anxiety were due to the nature and time of the study.

The result of this study is consistent with a study conducted in China that Arts students experienced more anxiety than students in other program (13). The study shows that educational institutions need to provide more awareness about COVID-19 among students pursuing Arts programs, which may further reduce anxiety about COVID-19. No studies have been conducted on the association between dwelling status and anxiety, but this study has found that students staying in a shared house or dorm (hostel) are more anxious about COVID-19 than those staying in a villa or apartment. Students who were anxious were often worried about the spread of COVID-19 and viral infection for themselves and their families (9). In this study students with a history of mental illness were significantly more anxious and stressful than those who did not have a history of mental illness. During COVID-19, most countries have implemented lockdown and suggested online classes, and this may impact students with no history of mental illness, but

would most likely affect students with a history of mental illness (6). Students with a history of mental illness, therefore, need to consult a mental health professional to protect themselves from COVID-19 anxiety, fear, and psychological distress.

In this study, the prevalence of psychological distress is higher (51%) compared to students in Spain 28.14% (5) during COVID-19. The major cause of psychological distress could be due to sudden lockdown, shifting from traditional classes to online classes, no social gathering, and fear and anxiety about COVID-19. Students who spend more than 4 h reading and watching information about COVID-19 are more anxious and psychologically distressed than those who spend less time on COVID-19. A study conducted in China found that health-care workers and younger people who spent more than 3 h reading and watching information about COVID-19 were more anxious than those who spent <2 h (10). This study recommends that students and the public reduce their time spent reading and watching about COVID-19 on social media as this may affect their anxiety and psychological distress levels. However, during lockdown, students are more engaged in social media, especially reading about COVID-19 (8, 26). Therefore, educational institutions can provide non-educational and educational online activities to engage students in useful activities.

The second hypothesis of this study, that staying in an apartment, age of participant, more than 4 h spent read about COVID-19, history of mental illness, anxiety, and fear significantly predict psychological distress, is partially accepted. The result of this study is partially consistent with other studies conducted overseas that anxiety and fear were associated with stress, but not with psychological distress (20, 32). This study regression model predicted only 45% of the variability on psychological distress. This indicate that there are other influential factors affecting psychological distress during COVID-19 were not captured by our study.

This is the first study that has found that the history of mental illness predicts psychological distress among the student population during COVID-19. Students who are staying in shared housing experienced more psychological distress as they may think that they are susceptible to COVID-19. Therefore, treating anxiety, fear, and the history of mental illness will most likely reduce the psychological distress among students during COVID-19. Students who experience higher psychological distress are more prone to substance abuse, insomnia, suicidal behavior, poor academic performance, and lack of concentration and attention (33–35). Hence, educational institutions need to be aware of the associated factors and consequences of psychological distress among students during COVID-19. Concurrently, students who think that they are experiencing or are prone to psychological problems should consult a mental health professional or student counselor to prevent the consequences of their illness.

Implications

During lockdown, students should find an alternative way to engage themselves usefully instead of reading excessively about COVID-19 as this study result shows that spending more

than 4 h reading about COVID-19 induces anxiety. Because the UAE government has opened most of the online apps for free communication, students could do online chatting and indulge in online group games with their friends. This would reduce excessive time spent reading about COVID-19. In this pandemic situation, students without a history of mental illness find difficulties coping with this unexpected situation, as do students with mental illness. However, students with a history of mental illness need to be more cautious as they are mentally more vulnerable to the aggravation of their mental illness during COVID-19. We suggest that educational institutions should provide some additional supportive counseling to students who have a history of mental illness as this study result shows that they are more prone to experiencing psychological distress.

Educational institutions need to provide more insight about COVID-19 among non-medical students, such as those in the arts and sciences, as they have less knowledge and are more anxious about COVID-19. We are aware that most of the educational institutions provide adequate awareness. However, conducting a frequent web-based question and answer session might help students to manage their doubts about COVID-19 and also alleviate their anxiety and fear related to COVID-19.

Limitation

First, this study data was collected using a convenience sampling method, and this may lead to sampling bias. The study data was collected from one university, but this university is one of the largest higher education institutions in the UAE, and students come from all the emirates and other Gulf countries. During the data collection period, most of the students had returned to their homes because of the lockdown. Hence, the sample may be considered representative of university students who live in the UAE. Third, if this study had been conducted before May 2020, the results may have been different, as at the beginning of the spread of COVID-19 students may have been more anxious and psychologically distressed. Last, this study used self-assessment questionnaires, which may lead to a biased result. Students who exhibited anxiety and psychological distress in the questionnaire were not interviewed clinically to confirm their diagnosis. However, all the studies conducted during COVID-19 had used self-assessment scale to screen the psychological problems.

Recommendations for Future Research

So far, all the studies among the student population have focused on domestic students, but not on international students. Therefore, measuring international students' anxiety, fear, and

psychological distress would be beneficial to know their psychological well-being status. Based on the results of this study, we recommend researchers use the COVID-19 anxiety and fear scales to assess anxiety and fear during COVID-19 rather than using general anxiety and fear scales as these may not evaluate COVID-19 anxiety and fear specifically. Screening for psychological distress and its predictors among the public would be beneficial. A similar study on a larger sample would be beneficial to allow comparison with the results of this study.

Conclusion

Overall, students have sufficient knowledge of COVID-19. Students in this study were found to have slightly less anxiety and fear of COVID-19 than was found in studies conducted overseas, while psychological distress was higher. Students studying arts and sciences are experiencing more psychological distress than students studying in medical and health science programs. Age, dwelling status, history of mental illness, anxiety, and fear significantly predicted psychological distress. Educational institutions need to provide academic and professional counseling to students to reduce their psychological distress and improve their academic performance.

DATA AVAILABILITY STATEMENT

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics and Research committee (REC-20-05-07-01) of the University of Sharjah. All the participants provided their online consent to participate in this study.

AUTHOR CONTRIBUTIONS

CS wrote the discussion section and arranged the manuscript. IM wrote the result section. WE and MT wrote the introduction section. All authors reviewed the manuscript and approved it. All authors contributed to the article and approved the submitted version.

ACKNOWLEDGMENTS

The authors like to say thank you to the students who participated in this study.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Negative Affect, Fatalism, and Perceived Institutional Betrayal in Times of the Coronavirus Pandemic: A Cross-Cultural Investigation of Control Beliefs

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OPEN ACCESS

Edited by:

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 31 July 2020

Accepted: 22 September 2020

Published: 26 October 2020

Citation:

Bachem R, Tsur N, Levin Y,
Abu-Raiya H and Maercker A (2020)
Negative Affect, Fatalism, and
Perceived Institutional Betrayal in
Times of the Coronavirus Pandemic: A
Cross-Cultural Investigation of Control
Beliefs. *Front. Psychiatry* 11:589914.
doi: 10.3389/fpsy.2020.589914

Background: A growing number of studies report that the COVID-19 pandemic has resulted in diverse aversive psychological reactions and created a global mental health crisis. However, the specific mechanisms underlying the negative emotional reactions as well as the differences between countries are only beginning to be explored. The present study examined the association of COVID-19-related fear and negative affect in Israel and Switzerland. The mediating roles of three control beliefs were explored, namely, fatalism, locus of control, and perceived institutional betrayal.

Method: General population samples of 595 Swiss and 639 Israeli participants were recruited and completed an online self-report survey. Moderated Mediation using multigroup path analysis models for the two samples were conducted and compared using AMOS.

Results: The multigroup path model had excellent fit for both samples. The different paths were moderated by country affiliation. Higher levels of COVID-19-related fear were associated with negative affect to an equal extent in both samples. COVID-19-related fear was associated with higher reports of institutional betrayal and a lower locus of control in both samples. Higher COVID-19-related fear was associated with lower fatalism in the Swiss sample only. In both samples, institutional betrayal mediated the association between COVID-19-related fear and negative affect, however, locus of control was a mediator in the Israeli sample only.

Conclusion: The current results suggest that the reaction of the government was of crucial importance with regard to the emotional state of the two populations. Interestingly, while in the context of adversity fatalism is generally considered a risk factor for mental health, during the time of the pandemic it seems to have had protective qualities among the Swiss population. Interventions that strengthen the personal locus of control have the potential to mitigate the negative affect in Israel but not in Switzerland. Despite the fact that COVID-19 is a global phenomenon, prevention and intervention strategies should be adjusted to local contexts.

Keywords: COVID-19, pandemic, negative affect, fatalism, locus of control, institutional betrayal, cross-cultural

INTRODUCTION

Since the beginning of the year 2020 the lives of people around the globe have been dominated by one particular stressor: the outbreak of the Coronavirus disease (COVID-19). A growing number of studies have reported on the extensive negative psychological reactions to COVID-19, which amount to a global mental health crisis (1). Due to the extremely high infection rates and relatively high mortality rates, the primary reactions to the pandemic have been fear, worry, and anxiety among people worldwide [e.g., (2–4)]. Emerging initial findings in a number of countries have documented evidence that high levels of COVID-19 related fear correlated substantially with elevated depression (2, 5), stress (6) poorer sleep quality (7), and lower mental wellbeing (8) in the general population. Moreover, levels of anxiety, depression and posttraumatic stress symptoms were reported to be higher during the COVID-19 pandemic than in previous population studies (9) (Shevlin et al. unpublished manuscript)¹.

However, the specific mechanisms that determine the debilitating effect of COVID-19 on mood and emotionality as well as cultural differences in this respect, are only beginning to be explored. Additionally, research is needed to better understand the importance of the local context for the response to the outbreak. The present study, therefore, examined the association of COVID-19 related fear and negative affect in two samples collected in Israel and Switzerland with the aim to identify potential mechanisms underlying this association.

As has been observed during previous epidemics, the COVID-19 pandemic has caused global anxiety and heightened stress (3). Ornell et al. (10) pointed out that during epidemics, the number of individuals whose mental health is affected is generally higher than the number of people who suffer from the infection, which necessitates exploring current and future mental health concerns (11). The pandemic does not only foster a concrete fear of death but is also accompanied by unprecedented economic and social repercussions that affect various spheres of family structures and professional life in unpredictable manners (10). Insecurity and fear of the unknown raise anxiety levels in healthy individuals as well as those with preexisting mental health conditions (12). In China, for example, approximately half of the respondents in a general population survey reported the psychological impact of the epidemic as moderate to severe (13), whereas in Italy, 41.8% of respondents from the general population reported high distress and 37.19% indicated high levels of anxiety (14). Furthermore, uncertainty about the risk of infecting family and friends tends to potentiate dysphoric mental states (15).

Although findings have shown that most people report a certain level of COVID-19 related fear (3), the reactions to the pandemic vary widely between individuals; some develop psychopathologies while others succeed to maintain psychological balance and adapt to the situation. It is therefore important to better understand the conditions under which individuals are able to cope with the uncertainty and

anxiety related to the pandemic. To date, most studies that investigated psychological responses to COVID-19 focused on sociodemographic risk factors such as gender, age, occupation, or education level [e.g., (6) (Shevlin et al. unpublished manuscript)¹] or social variables such as social support or loneliness (16, 17). Nevertheless, other factors have not yet been thoroughly explored.

Expert opinions predominantly highlight the importance of individual control, beliefs, and perceptions of helplessness with regard to suffering from emotional distress during the present pandemic (8, 10, 18, 19). More specifically, Satici et al. (8) found that intolerance for uncertainty had a significant direct effect on mental wellbeing during the COVID-19 situation. Independent of the specific context of the COVID-19 pandemic, research has firmly suggested that self-mastery is a crucial criterion for promoting wellbeing in times of crisis (20). The current study is among the first to empirically assess individuals' unique perceptions of control on three levels: fatalistic world views (reflecting the propensity to believe that one's destiny is externally determined), health locus of control (reflecting trust in self as able to cope with the pandemic), and perceptions of institutional betrayal (reflecting trust in authorities to protect against the virus) in the context of coping with COVID-19.

The first concept of interest, fatalism, describes the general belief that one's destiny is externally determined and that one's actions have little or no significant impact on important outcomes (21). A fatalistic attitude of life can result in reduced fear and anxiety in highly threatening situations, particularly when efforts to engage in direct means of resolving the conflict seem futile (22). Thus, choosing to disengage with the stressor can be an effective way to eliminate the tension created by a situation that is perceived as threatening and uncontrollable. At the same time, however, higher fatalism has also been shown to be strongly and positively associated with hopelessness and depression [e.g., (23)] and, to a lesser extent, with increased symptoms of general psychological distress (24). Hence, in the current COVID-19 crisis, fatalistic views may have a complex effect on mental health and wellbeing. While fatalistic control beliefs may reduce COVID-19 related fears, this strategy may come at the cost of higher levels of negative affect (22).

The second concept of interest, health-related internal locus of control, refers to people's attribution of their own health to either personal or environmental factors (25). Perceived control over outcomes primes individuals to view difficult situations as challenges rather than insurmountable obstacles and enables them to choose adaptive coping strategies (26). There is an extensive body of research linking a high locus of control with psychological health, indicated by fewer symptoms of anxiety, depression, and faster recovery after confronting adverse life circumstances (27–29). In the current study, the health locus of control reflects the degree to which an individual trusts in themselves as capable of coping with the COVID-19 pandemic. A recent study conducted during the COVID-19 crisis showed that a general sense of control mediated the association between stress symptoms and positive mental health. This suggests that a sense of control fosters calmer management of the current challenges and has the potential to buffer any negative mental health consequences of the pandemic (30).

¹https://www.researchgate.net/publication/340763183_Anxiety_Depression_Traumatic_Stress_and_COVID-19_Related_Anxiety_in_the_UK_General_Population_During_the_COVID-19_Pandemic (accessed October 13, 2020).

When facing a global crisis, such as the spread of COVID-19, it seems that the government and healthcare systems play a significant role in the degree to which the new virus threatens individuals and societies. Perceived institutional betrayal, the third concept of interest, occurs when people perceive powerful and trusted institutions as causing harm to those dependent on them for safety and wellbeing, either by action or inaction in times of crisis or when mistakes or crimes have been committed (31). This type of perceived betrayal has largely been discussed in the context of cover-up attempts of sexual assaults in the Catholic church, the military, or within universities (32). In addition, it is known to exacerbate various psychopathological reactions to adversity and trauma, such as anxiety, depression, and posttraumatic stress disorder (33, 34). In the context of the COVID-19 crisis, the subject of institutional betrayal is now beginning to be discussed in regards to medical systems, both because of a lack of adequate provision of care for patients as well as the failure to provide sufficient personal protective equipment to health care staff (35, 36). In the current project, perceived institutional betrayal refers to people's lack of trust in the local government and healthcare institutions to protect against the virus (i.e., the level to which participants felt that these institutions took inadequate action to protect personal and public health and wellbeing).

Despite the fact that COVID-19 is a global phenomenon, relatively few studies have focused on the similarities and differences of mental health reactions to COVID-19 between different countries. Therefore, the current study explores two general population samples collected in two different countries: Switzerland and Israel. These two countries are of particular interest as they entail several differences as well as similarities. Although the population size in these countries is very similar (8.57 million in Switzerland and 9.23 million in Israel), the sociopolitical climate, economic status, as well as mentality, are significantly different. Concerning the COVID-19 outbreak, both countries experienced significant health risks to the population, however, these challenges were dealt with differently by the two governments.

The aim of this study was to assess the association between COVID-19 related fears and negative affect as well as potential differences between the two countries. A moderated competitive mediation model was suggested, wherein country affiliation would moderate the direct and indirect paths. We hypothesized that a lower locus of control, higher fatalism, and higher perceived institutional betrayal would be associated with more COVID-19 related fear and more negative affect. We also assumed that the three types of control perceptions would mediate the association of COVID-19 related fear and negative affect. We also aimed to identify the most relevant control-related mediator in regards to negative emotions to determine potential starting points for interventions.

METHODS

Participants and Procedure

This study was conducted during the peak of the COVID-19 outbreak in Switzerland and Israel when both countries were in

lock-down. The educational systems were closed, classes took place online, and most people were working from home. In Israel, data collection took place from March 30 to May 16, 2020. During the initial stage of the data collection, there were 4,695 verified cases of COVID-19 and 16 deaths in Israel. By the end of the data collection, there were 16,607 verified cases and 268 deaths. During the majority of this time, the Israeli government had imposed quarantine on the entire population, apart from limited activities, such as healthcare and essential grocery shopping. In Israel, recent studies identified elevated levels of depression which were predicted by loneliness due to the social-distancing policy (37). In particular, COVID-19 related worries were associated with heightened anxiety and depression (38). Notably, during the COVID-19 outbreak, unemployment rates in Israel increased from 4% to ~27% of the population [1.276 million people; (39)].

In Switzerland, data collection commenced on April 24, when there were 29,014 verified cases of COVID-19 and 1,496 deaths. By the end of data collection on May 23, there were 30,628 verified COVID-19 cases and 1,677 deaths. While the population had not been required to be in quarantine, it was strongly recommended for people to remain at home during the time of the data collection. As in Israel, first studies conducted in Switzerland among student populations suggest that COVID-19 specific worries, lack of interaction and emotional support, and physical isolation were associated with negative mental health trajectories [e.g., (40)]. Unemployment rates in Switzerland were reported to be 3.3% in April and 3.4% in May. However, in April 2020, around one quarter of the working population had reduced working hours as a result of the government's action plan to control the negative impact of COVID-19 on the population (41).

A convenience sample of 595 Swiss and 639 Israeli participants was recruited via avenues of social media (e.g., Facebook) and a snowball technique. Participants were invited to participate in a study aiming to uncover psychosocial coping with challenges regarding COVID-19. Questionnaires were distributed electronically in local languages (i.e., German in Switzerland, and Hebrew and Arabic in Israel), using Unipark and Qualtrics Research Software. Inclusion criteria were a) above the age of 18, and b) fluent in the local language(s). The study was approved by the Institutional Review Boards in each country and all participants signed a consent form.

Measures

Exposure to COVID-19 was assessed using 7 questions specifically tailored to assess COVID-19-related stressors (42). Participants were asked whether or not they were exposed to various COVID-19-related incidents (e.g., getting infected, quarantined, a family member got infected or quarantined, knowing someone who died from COVID-19). Overall exposure was calculated by summing all of the positive answers to exposure questions, with higher scores indicating higher exposure to COVID-19.

Fear of COVID-19 was evaluated by three questions specifically tailored to the COVID-19 experience (42). Participants were asked to rate the extent to which they

fear the situations presented to them (“I am worried that I or my family could get infected or quarantined,” “I am afraid that the epidemic will spread widely and last long,” “I am afraid of the negative impact the COVID-19 will have on my life.”) on a five-point Likert scale, ranging between 1 (not at all) to 5 (very much). The fear of COVID-19 score was calculated by the summation of all of the responses to all items, with higher scores indicating higher COVID-19 fear. Cronbach’s alphas were 0.71 and 0.76 for the Swiss and the Israeli samples, respectively, indicating acceptable reliability.

Fatalism was evaluated using the six-item Fatalism scale (43, 44). This scale assesses the degree to which one believes that destiny is externally determined, including two subscores: pessimistic and non-judgmental fatalism (44). Participants are asked to rate the extent to which each of the items is true for them, on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Example items include: “I have learned that what is going to happen will happen,” “If bad things happen, it is because they were meant to happen.” The fatalism score was calculated by summing the responses to the six items, with higher scores indicating higher fatalism. Recent findings have demonstrated the scale’s cross-cultural validity and reliability (44). In the current sample, Cronbach’s alpha for the Swiss sample was 0.86 and 0.85 for the Israeli sample, indicating high reliability.

Health-related internal locus of control was measured with the Internal Health Locus of Control Scale [IHLC; (45)]. This six-item scale assesses the extent to which participants believe that their health is under their own control, determined by their own behavior. Participants were asked to rate, on a six-point Likert scale, the degree to which they agree with each item, ranging from 1 (strongly disagree) to 6 (strongly agree). Example items include: “I am in control of my health,” “If I take the right actions, I can stay healthy.” The locus of control score was calculated by summing the responses to all of the items, with higher scores indicating higher believed self-control. One item was omitted from the analysis due to a technical error. Nevertheless, this error did not appear to affect the reliability of the scale, as Cronbach’s alpha for the Swiss sample was 0.84 and 0.87 for the Israeli sample, indicating high reliability.

Perceived institutional betrayal was assessed by a new questionnaire, partially based on the Institutional Betrayal Questionnaire—Health [IBQ-H; (46)]. The new questionnaire was adapted to measure the level to which participants perceived the local government and healthcare institutions as taking sufficient action in the face of the pandemic or, rather, betrayed their obligation to protect personal and public health and well-being. Respondents were instructed to report their agreement with each of the 12 items on a five-point Likert scale, ranging between 1 (completely disagree) to 5 (completely agree). For example: “The institutions betrayed your trust in them,” “Increased your risk of becoming sick/getting infected,” “Their actions reflect interests other than enhancing and protecting your health.” The total institutional betrayal score was calculated by the summation of the responses to all of the items. Cronbach’s alphas for both the Swiss and Israeli samples were 0.91, indicating high reliability.

Negative affect was assessed using the negative affect subscale from the Positive and Negative Affect Schedule—Short form (PANAS; 48). The PANAS negative affect subscale consists of five emotions, including afraid, upset, and distressed. Participants were instructed to rate the extent to which they experienced each of the emotions during the last 2 weeks on a five-point Likert scale ranging between 1 (very little) to 5 (very much). The PANAS-negative affect score was calculated by summing the responses to all of the items, with higher scores indicating higher negative affect. Previous findings have documented the scale’s validity and reliability (47). Cronbach’s alphas were 0.81 and 0.89 for the Swiss and the Israeli samples, respectively, indicating high reliability.

Data Analysis

First, the groups’ background and demographic variables were compared. Additionally, independent sample *t*-tests were performed to assess the differences between the Swiss and Israeli samples in the main study variables. Next, Pearson correlation analyses were performed for each sample separately to assess the correlations between the study variables. Finally, we conducted a Multi-Group Path analysis in AMOS 23 software, which estimated the relation between fear of COVID-19 and negative affect as well as the indirect effects via fatalism, locus of control, and institutional betrayal. We also examined the model separately for the Israeli and Swiss samples. We controlled for age and gender and their associations with negative affect and the three mediators. We used age and gender because of differences between countries in these variables and since they were significantly associated with negative affect in both countries. The number of individuals in the household and education did not correlate with negative affect in either of the samples. The following indices were employed to determine whether the hypothesized models fit the data. A good model fit is indicated by a non-significant χ^2 , goodness-of-fit values as the comparative fit index (CFI), non-normed-fit index (NNFI), Tucker-Lewis Index (TLI) greater than .90, and a root-mean-square error of approximation (RMSEA) below 0.06 (48). We limited the paths between the countries to be significant and examined the differences between the χ^2 of the constrained and free models. A significant $\chi^{2\Delta}$ indicated that the paths were significant between the countries.

RESULTS

Differences Between the Swiss Sample and the Israeli Sample

Background variables of the Swiss and Israeli samples are depicted in **Table 1**. As can be seen, some differences were found between the samples in terms of age, gender, education level, and the number of people in a household. Additionally, the Israeli sample reported an experience of significantly greater financial loss due to the COVID-19 outbreak, compared to the Swiss sample.

As can be seen in **Table 2**, although no differences were found between the Swiss and Israeli samples in exposure to COVID-19 related stressors, significant differences were found between the two samples in all of the study variables. Specifically,

TABLE 1 | Demographic characteristics by study group.

	Swiss sample (<i>n</i> = 582)	Israeli sample (<i>n</i> = 639)	Chi square/ Independent sample <i>t</i> -test
Gender			
Female	439 (73.8%)	534 (84.1%)	Chi square (1) = 19.77
Male	156 (26.2%)	101 (15.9%)	$p < 0.001$
Age ^a (M, SD)	43.15, 14.77	47.25, 14.38	$t(1,200) = 4.88$ $p < 0.001$
Education level			
Primary/middle school	157 (26.4%)	3 (0.5%)	Chi square (2) = 235.54
Highschool	98 (16.5%)	42 (6.6%)	$p < 0.001$
Academic	340 (57.1%)	587 (92.9%)	
Number of people in household (M, SD)	2.68, 1.57	3.02, 1.58	$t(1,211.44) = 3.81$ $p < 0.001$
Financial loss since COVID-19 outbreak			
No financial loss	418 (70.5%)	123 (19.2%)	Chi square (2) = 331.08
Minor financial loss	135 (22.8%)	356 (55.7%)	$p < 0.001$
Major financial loss	40 (6.7%)	160 (25%)	

^aAge range: 18–99 years. Age distribution: 18–29 years (Switzerland: *n* = 132, 22.2%; Israel *n* = 62, 9.7%) 30–59 years (Switzerland *n* = 357, 60.0%; Israel *n* = 413, 64.6%), 60–99 (Switzerland: *n* = 104, 15.5%; Israel *n* = 134, 21%).

TABLE 2 | Study variables by study group.

	Swiss sample (<i>n</i> = 595)	Israeli sample (<i>n</i> = 639)	Independent sample <i>t</i> -test
Exposure to COVID-19 (M, SD)	1.41, 1.44	1.38, 1.15	t -test (1,204) = 0.3 $p = 0.77$
Fear of COVID-19 (M, SD)	6.32, 1.82	7.82, 2.01	t -test (1,232) = 13.68 $p < 0.001$
Fatalism (M, SD)	15.02, 5.65	16.1, 5.11	t -test (1,232) = 3.53 $p < 0.0015$
Locus of control (M, SD)	20.38, 4.32	22.72, 4.43	t -test (1,229) = 9.45 $p < 0.001$
Institutional betrayal (M, SD)	19.13, 8.79	34.68, 9.33	t -test (1,232) = 30.1 $p < 0.001$
Negative affect (M, SD)	10.09, 4.01	12.24, 4.84	t -test (1,232) = 8.47 $p < 0.001$

Exposure to COVID-19 range: 0–7; Fear of COVID-19: 3–12; Fatalism range: 0–30; Locus of control range: 5–35; Institutional betrayal range: 12–55; Negative affect: 4.86–25.

the findings revealed that, compared to the Swiss sample, the Israeli sample experienced a higher fear of COVID-19 as well as higher fatalism, locus of control, and negative affect. Notably, the Israeli sample reported remarkably higher levels of perceived institutional betrayal than the Swiss sample.

Intercorrelations Between the Study Variables

As depicted in **Table 3**, the analyses revealed that exposure to COVID-19 was correlated with fear of COVID-19 in the Swiss sample, however, this was not found in the Israeli sample. Among both the Swiss and Israeli samples, fear of COVID-19 was inversely correlated with locus of control and positively correlated with institutional betrayal and negative affect. A significant inverse correlation between fear of COVID-19 and fatalism was observed only in the Swiss sample. Finally, in both

samples, negative affect was inversely correlated with locus of control and positively correlated with institutional betrayal.

Moderated Mediation

We assessed whether the association between fear of COVID-19 and negative affect differed between the Israeli and Swiss samples. Additionally, we examined the potential mediating role of fatalism, locus of control, and perceived institutional betrayal. We controlled for the effects that age and gender bear for negative affect and for the three mediators, fatalism, locus of control, and perceived institutional betrayal. To this end, we ran multigroup path analysis models that estimated the relation between fear of COVID-19 and negative affect, and the indirect effects via fatalism, locus of control, and institutional betrayal, controlling for age and gender, separately for the Israeli and Swiss samples. The multigroup model fit the overall data well, $\chi^2(N = 1,234, df = 16) = 76.61$, $p < 0.001$, CFI = 0.91, NNFI = 0.93,

TABLE 3 | Intercorrelations between study variables.

	Exposure to COVID-19	Fear of COVID-19	Fatalism	Locus of control	Institutional betrayal	Negative affect
Exposure to COVID-19	1	0.13**	−0.074	−0.06	0.004	0.074
Fear of COVID-19	0.004	1	−0.12**	−0.26***	0.09*	0.52***
Fatalism	−0.084*	0.009	1	0.19***	0.15***	0.024
Locus of control	−0.025	−0.12**	0.14***	1	0.14**	−0.12**
Institutional betrayal	−0.053	0.094*	−0.024	0.07	1	0.32***
Negative affect	0.01	0.54***	0.045	−0.16***	0.13**	1

Results above diagonal reflect intercorrelations among Swiss sample, and results under diagonal reflect intercorrelations among Israeli sample. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

TLI = 0.92, RMSEA = 0.055, 90% CI [0.042, 0.068]. However, the model fit the data only adequately for each individual sample though in both samples RMSEA was high: $\chi^2(N = 639, df = 8) = 33.72, p < 0.001$, CFI = 0.91, NNFI = 0.93, TLI = 0.93, RMSEA = 0.071, 90% CI [0.047, 0.097] for the Israeli sample and, $\chi^2(N = 595, df = 8) = 42.89, p < 0.001$, CFI = 0.91, NNFI = 0.93, TLI = 0.92, RMSEA = 0.086, 90% CI [0.062, 0.112] for the Swiss sample (see **Supplementary Materials 1**). In both samples higher age was associated with lower negative affect and being male was related to lower levels of negative affect compared to being female. In both samples, being male was associated with lower fatalism, but gender was not related to locus of control of institutional betrayal. In the Israeli sample, higher age was related to higher institutional betrayal and lower fatalism, but it was not related to locus of control. However, in the Swiss sample, higher age was associated with higher fatalism, but not with institutional betrayal or locus of control. Since the model fit was not optimal, we then examined a nested model.

The control variables were removed from the models and excellent model fit was found with similar effects, both in estimates' direction and intensity. The multigroup model fit the overall data well, $\chi^2(N = 1234, df = 6) = 8.87, p = 0.018$, CFI = 0.99, NNFI = 0.99, TLI = 1.00, RMSEA = 0.02, 90% CI [0.000, 0.045], as well as data collected from each sample: $\chi^2(N = 639, df = 3) = 6.59, p = 0.090$, CFI = 0.99, NNFI = 0.98, TLI = 0.99, RMSEA = 0.043, 90% CI [0.000, 0.089] for the Israeli sample and, $\chi^2(N = 595, df = 3) = 2.28, p = 0.520$, CFI = 1.00, NNFI = 1.00, TLI = 1.01, RMSEA = 0.000, 90% CI [0.000, 0.062] for the Swiss sample. The differences between the models' Chi square was not significant, (p 's ranged 0.23 to 0.69), which indicates that the more parsimonious model is favorable (**Figure 1**).

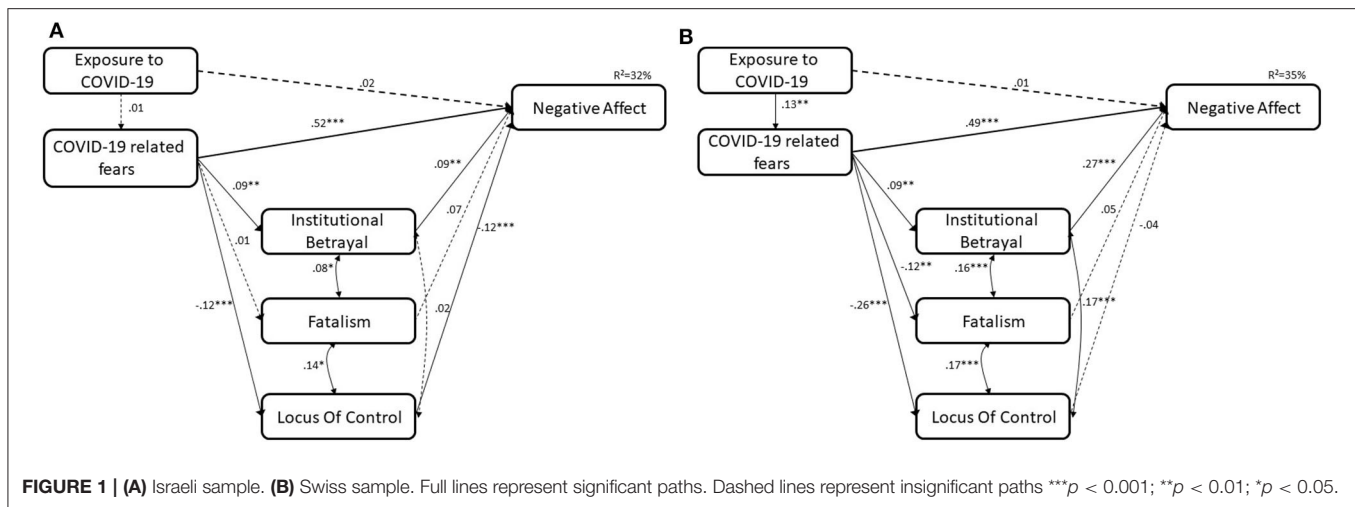
The analysis revealed that for both the Israeli and Swiss samples, higher levels of fear of COVID-19 were related to higher levels of negative affect. This path was not significant between the groups, $\Delta\chi^2(7) = 10.79, p = 0.150$. In both the Israeli and Swiss samples, higher fear of COVID-19 was related to higher institutional betrayal. This path was equal between the samples, $\Delta\chi^2(7) = 8.87, p = 0.262$. However, the samples differed in regard to the associations between fear of COVID-19 and fatalism and locus of control. In both the Israeli and Swiss samples,

the path between fear of COVID-19 and locus of control was significant, indicating that higher fear of COVID-19 was related to lower locus of control, although in the Swiss sample it was stronger, $\Delta\chi^2(7) = 17.11, p = 0.017$. A difference between the samples was found in the associations between fear of COVID-19 and fatalism. While in the Israeli sample this path was not significant, in the Swiss sample it was significant and showed that higher fear of COVID-19 was related to lower fatalism, $\Delta\chi^2(7) = 15.08, p = 0.035$.

The relationship between institutional betrayal and negative affect was significant in both samples, indicating that higher institutional betrayal was associated with higher negative affect, although this path was significantly stronger in the Swiss sample, $\Delta\chi^2(7) = 18.96, p = 0.008$. In the Swiss sample, the associations between fatalism and lower locus of control, on the one hand, and negative affect, on the other hand, were insignificant. However, in the Israeli sample, the path between lower locus of control and negative affect was significant, indicating that a higher locus of control was associated with lower negative affect. The difference between samples in this path was not significant, $\Delta\chi^2(7) = 12.33, p = 0.090$. In addition, the association between fatalism and negative affect was marginally significant in the Israeli sample. The difference between the samples in this path was not significant, $\Delta\chi^2(7) = 9.11, p = 0.245$.

The total indirect effect (comprised of the sum of the three indirect effects) was significant in the Israeli sample (total indirect effect: Estimate = 0.06, $se = 0.02$, 95% CI [0.0270, 0.0980]) but insignificant in the Swiss sample (total indirect effect: Estimate = 0.06, $se = 0.04$, 95% CI [−0.0070, 0.1190]). The indirect effects via fatalism were not significant in either sample (all 95% CI included 0). However, the indirect effects via institutional betrayal were significant in both the Israeli (indirect effect: Estimate = 0.02, $se = 0.01$, 95% CI [0.0020, 0.0460]) and the Swiss (indirect effect: Estimate = 0.05, $se = 0.03$, 95% CI [0.0140, 0.1150]) samples. The indirect effect via locus of control (indirect effect: Estimate = 0.03, $se = 0.01$, 95% CI [0.0080, 0.0630]) was significant in the Israeli sample but not in the Swiss sample (indirect effect: Estimate = −0.01, $se = 0.02$, 95% CI [−0.0560, 0.0260]).

The results indicate that there are moderated mediations with the country as the moderator. In the Israeli and Swiss



samples, higher levels of fear of COVID-19 were related to higher institutional betrayal, which was associated with a higher negative affect. In the Israeli sample, higher levels of fear of COVID-19 were related to higher locus of control, which was associated with higher negative affect. Fatalism did not mediate the path between fear of COVID-19 and negative affect.

DISCUSSION

It is a basic human instinct to strive for control when adversity strikes. In this study, we sought to explore three different control perceptions (fatalism, internal locus of control, and perceived institutional betrayal) as potential mediators of the association between COVID-19 related fear and negative affect in two samples collected during the lockdown periods in Israel and Switzerland. This study aims to contribute to our understanding of the mechanisms associated with negative affect in the general population during a global health crisis and to better understand the role the local context plays in the stress response. The results revealed that perceived institutional betrayal was the strongest mediator of the association between COVID-19 related fear and negative affect, which was significant in both samples. In addition, health related internal locus of control was a mediator among the Israeli sample only.

As was found in previous studies [e.g., (2, 5)], the association between COVID-19 related fears and negative affect was substantial in both samples, corresponding to a medium-large effect size. In contrast, actual exposure to COVID-19 was unrelated to negative emotions among individuals from both countries, which suggests that in the context of COVID-19, subjective appraisals rather than objective threats determined emotional adjustment. Similar observations have previously been made across a variety of contexts related to impaired physical health, such as among cancer patients [e.g., (49)]. Although self-rated exposure to COVID-19 was equal in the two samples, distress levels were different. Israeli participants reported significantly higher COVID-19 related fear and more negative affect.

The Role of Institutional Betrayal

Perceived institutional betrayal was the concept of interest that explained most of the variance in the current model. In both Switzerland and Israel, higher COVID-19 related fears were associated with reduced trust in local government and healthcare institutions to protect against the virus and a higher perceived institutional betrayal was associated with more negative emotions. In addition, institutional betrayal mediated the association between COVID-19 related fears and negative affect in both samples. These findings highlight the central role of the authorities in an individual's mental well-being during times of crisis. In a situation as threatening as a pandemic, people turn toward the authorities whose responsibility includes supporting and protecting the individual. If such support is not granted, it is a grave source of distress. The current results thus suggest that in order to mitigate the negative psychosocial consequences of COVID-19, special attention should be paid to strengthening trust in the authorities as this has the potential to buffer the negative impact of fears. Future research should formally explore the specific factors that influence perceptions of institutional betrayal and develop appropriate intervention strategies. The ongoing pandemic offers the chance to learn important lessons that may serve to improve general crisis management in the future.

Interestingly, there was a striking difference in perceived institutional betrayal in the two samples with significantly higher mean values in Israel ($M = 34.7$) compared to Switzerland ($M = 19.2$). It is likely that an important contributor to the conspicuously high levels of institutional betrayal in Israel was the economic difficulties the country encountered during the lockdown period. While in Switzerland unemployment rates remained stable during the data collection phase, in Israel they increased from 4% to ~27% and, consequently, Israelis reported higher financial loss compared to the Swiss participants (see **Table 1**). In support of this explanation, recent findings have shown that Israelis who received more financial compensation from the government during the lockdown were more likely to comply with the imposed restrictions (50). Additionally,

the significantly higher perceived institutional betrayal among Israelis may also reflect circumstances predating the COVID-19 crisis, such as political turmoil and related distrust in the political leadership, which may also have decreased Israeli trust in government and healthcare institutions. Switzerland, on the other hand, did not experience political unrest before the pandemic. The high levels of perception of institutional betrayal could at least partially explain why the Israeli sample suffered from higher fear and negative emotions during the study period, despite lower numbers of infections and deaths due to COVID-19.

The Role Internal Locus of Control

In line with the hypotheses, less fear of COVID-19 was associated with higher health locus of control in both samples, thereby extending findings by Brailovskaia and Margraf (30) who showed negative associations of general (not health-related) sense of control and burden by COVID-19. However, even though health locus of control was correlated with negative affect, in Switzerland it did not mediate the association of interest in the path model. This finding suggests that among the Swiss, health locus of control did not explain variance in negative affect above and beyond the other study variables. In fact, the only control perception that was associated with negative affect in the Swiss model was institutional betrayal. Contrarily, in Israel, health locus of control also mediated the association of fear and negative affect. It may be speculated that surviving multiple wars and adversities may have enabled a “survivor” identity, in which it is particularly important to take personal, active control in the face of these difficulties (51, 52). As such, it is possible that the sense of personal control over one’s health is particularly relevant for Israelis when facing an uncontrollable stressor, such as the COVID-19 pandemic. As a second explanation, it may be speculated that in the face of high perceived institutional betrayal personal means of control may become more important. The significant and positive correlation of perceived institutional betrayal and locus of control indicates that this may be the case.

The Role of Fatalism

In Switzerland, COVID-19 related fear was associated with increased fatalism. This is in line with previous research that found negative associations of fatalism and anxiety [e.g., (22, 53)]. From a self-regulation perspective, disengaging from perceptions of control may resolve the conflict that arises from the insecurities related to a new situation, such as the COVID-19 crisis, in which an individual has little control over the course of events (22). Hayes and Clerk (54) conducted an experimental study which showed that COVID-19 related fatalism could be deliberately influenced by manipulating control beliefs. While a fatalistic message arguing that the pandemic is unstoppable and that mitigation efforts may do more harm than good increased fatalism, an optimistic message that drew attention to the effectiveness of coping efforts and collective connectedness in times of need reduced fatalism. Furthermore, several recent studies reported that more fatalistic beliefs about the infectiousness of COVID-19 were less likely to comply with preventive measures (55, 56). In Israel, however, higher fear

of COVID-19 was unrelated to fatalism, which differs from the findings in the Swiss sample as well as the US sample of Hayes and Clerk (54). One explanation for these differences could be embedded in the cultural differences between the two countries. As described above, the geopolitical circumstances in Israel are complex and since its establishment, the Palestinian and Israeli populations have faced ongoing tension and conflict. This prolonged sense of threat may have resulted in higher general fatalism, which was unaffected by COVID-19 related fears. Indeed, the Israeli sample reported significantly higher fatalism than the Swiss sample. Previous theorists have described fatalism as a social axiom (57), which suggests that it develops through the interaction of a cognitively and emotionally active person and his or her socially structured environment (58). As such, cultural differences regarding the function of fatalism seem to be explainable. Indeed, previous research has shown significant mean-level differences in fatalism between different European and African countries (44).

Finally, contrary to our hypothesis, higher fatalism was not associated with a stronger negative affect in either of the samples and also did not represent a mediator in the current model. Despite previous findings, which have shown strong positive associations between fatalism with psychological distress (24) and depression (54), in the current study no such effect was found. Although in the context of adversity fatalism is generally considered a risk factor for mental health and well-being, the data suggest that during the COVID-19 pandemic this was not the case. Further research is necessary to uncover the association between fatalism and distress, including an exploration of its underlying explanatory mechanisms.

Several limitations should be acknowledged when interpreting the current findings. First, the samples were recruited via social media and, therefore, are not representative of the Swiss and Israeli populations, which limits the generalization of the results. Additionally, females were overrepresented in the sample and participants were relatively highly educated. Second, the cross-sectional nature of the data does not allow for any inferences on causality. Third, the study relied on self-report data rather than clinician-administered interviews. Due to the urgency of the COVID-19 pandemic, the questionnaires assessing institutional betrayal as well as COVID-19 exposure and fear had not been validated in Israeli and Swiss populations. Finally, comorbid mental health problems are likely related to negative affect during the COVID-19 pandemic but have not been considered in the current models. Nevertheless, given the timeliness of the research question and the urgency of understanding negative emotional reactions in the context of the COVID-19 pandemic, this first examination yielded important exploratory information on predictors of COVID-19 related mental health burdens. Future research should evaluate how they relate to other risk factors, such as temperament traits and related personality constructs, which have been shown to be relevant to the mental health response to COVID-19 (59).

Within the framework of these empirical findings, it can be concluded that the reaction of the authorities appears to be of crucial importance with regard to the emotional state and well-being of the population in both countries. As international

experts warn of a possible rise in mental health problems in the aftermath of COVID-19 (11, 60, 61), a vital next step would be to closely investigate the factors accounting for the perceptions of institutional betrayal in order to take measures to lower it and, thereby, also buffer the negative impact of the COVID-19 crisis on people's mental health. However, the findings emphasize that, even though COVID-19 was associated with fear as well as negative affect in Israel and Switzerland, significant differences were also identified. The current results thus suggest that, in Israel, interventions strengthening the health locus of control would have more potential as a means to stop the spill-over from specific fears to negative affect. Presuming replications of these findings, strengthening the health locus of control would be a potential intervention target. Despite the fact that COVID-19 is a global phenomenon, prevention and intervention strategies should be adjusted to local contexts.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Review Boards of the University of Zurich and Tel Aviv University. The patients/participants

provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

RB: contributed to the conceptualization and design of the study, collected the data in Switzerland, and drafted the manuscript. NT: contributed to the conceptualization and the design of the study, collected the data in Israel, contributed to the data analysis and reporting, and conducted a critical review of the manuscript. YL: contributed to the conceptualization and the design of the study, contributed to the data analysis and reporting, and conducted a critical review of the manuscript. HA-R and AM: contributed to the conceptualization and the design of the study and conducted a critical review of the manuscript. All authors contributed to the article and approved the submitted version.

ACKNOWLEDGMENTS

The authors would like to thank Prof. Karni Ginzburg of Tel Aviv University for her contribution to this manuscript.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2020.589914/full#supplementary-material>

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Beneficial Effects of Exercise on Depression and Anxiety During the Covid-19 Pandemic: A Narrative Review

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OPEN ACCESS

Edited by:

Andreas Maercker,
University of Zurich, Switzerland

Reviewed by:

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 26 July 2020

Accepted: 14 October 2020

Published: 04 November 2020

Citation:

Hu S, Tucker L, Wu C and Yang L
(2020) Beneficial Effects of Exercise
on Depression and Anxiety During the
Covid-19 Pandemic: A Narrative
Review. *Front. Psychiatry* 11:587557.
doi: 10.3389/fpsy.2020.587557

First reported in Dec 2019, the on-going COVID-19 pandemic has become a public health emergency of international concern (PHEIC). The isolation and quarantine during the COVID-19 pandemic limited the physical and social activities of the population, which contributed to the increased prevalence of mental disorder. Depression and anxiety are the most common mental illnesses conferring a serious impact on individuals' life quality. This review summarizes the mental health consequences of COVID-19, especially for depression and anxiety. Exercise as an intervention for anxiety and depression has been demonstrated in both of the animal studies and human clinical trials. The underlying mechanism including the regulation on the production of brain-derived neurotrophic factor (BDNF), D- β -hydroxybutyrate, synaptic transmission, hypothalamic pituitary adrenal (HPA) axis, tryptophan hydroxylase, GSK3 β / β -catenin pathway, neuroinflammation, oxidative stress and PGC-1 α 1-PPAR axis. In addition, we summarized the exercise strategies to fight against anxiety and depression according to the information from American College of Sports Medicine (ACSM), World Health Organization and recent literatures about physical exercise during COVID-19.

Keywords: physical exercise, depression, anxiety, COVID-19, isolation, quarantine

INTRODUCTION

Since the first coronavirus infection (COVID-19) case reported in Dec 2019, the COVID-19 continue to emerge and represent a serious issue to public health (1). In the past several months, increased number of confirmed coronavirus cases and deaths, stay-at-home restriction and tons of information about COVID-19 inevitably conferred impact on people's mental health, especially for people already living with mental disorder (2). According to a perspective article published in the *New England Journal of Medicine*, depression and anxiety may develop to be side effects of COVID-19 after the Covid-19 Pandemic (3). However, the medical care required to large number of COVID-19 cases induced the currently ignorance regarding public mental health during the coronavirus pandemic (1, 3).

According to previous studies, more than 50% of patients with severe acute respiratory syndrome (SARS) and middle east respiratory syndrome (MERS) experienced varying degrees of mental disorder after the outbreak of SARS in 2003 and MERS in 2015 (1, 4), indicating

widespread outbreaks of infectious diseases were usually closely related to the increased prevalence of mental disorders (5). Among these disorders, anxiety and depression are the most common mental illnesses conferring a serious impact on individuals' life quality (6). Researchers in China investigated the psychological impact of the COVID-19 during the initial stage of coronavirus and found a high percent of the respondents with moderate to severe depressive (16.5%) and anxiety (28.8%) symptoms (7). Although emergency psychological crisis interventions has been performed to reduce the mental impact induced by COVID-19, changings to the public mental health still exist (8).

The beneficial effect of exercise on improving physical health and fighting disease has been widely studied (9, 10). A large body of evidence suggested regular exercise could significantly reduce the risk of depression, anxiety and considered to be beneficial in the prevention of about 25 conditions (11–14). Furthermore, physical inactivity has been considered as a modifiable risk factor for numerous diseases including depression and anxiety (15). Here, we reviewed the recent studies concerning mental health related to COVID-19 coronavirus and the beneficial role of exercise against anxiety and depression. Exercise type, exercise frequency, exercise intensity and the underlying mechanism will be discussed.

Method

We conducted a narrative review of recent studies concerning mental health related to COVID-19 coronavirus and the beneficial role of exercise against anxiety and depression.

A literature search within the PubMed and Web of Science databases was conducted. Literatures with clear description of exercise type, exercise frequency, exercise intensity and effect of exercise on anxiety and depression were included.

INCREASED RISK OF MENTAL DISORDERS DURING THE COVID-19 PANDEMIC

As a “public health emergency of international concern (PHEIC)” for the entire world, COVID-19 has caused a rapid growth in the number of confirmed and suspected cases in the past several months (16). Isolation and quarantine were proven as effective measures contributing to the successful containment of the COVID-19 in China and other regions (17). Isolation was defined as the separation and activity restriction of ill persons with infectious disease to prevent its transmission to others. The definition of quarantine differs from isolation referring to the activity restriction of healthy persons who have been exposed to an infectious disease and may suffer with this disease in the future (18). Although the isolation and quarantine were two of the effective disease-control methods according to previous experience including SARS in 2003 (18), people in quarantine or isolation reported a high prevalence of symptoms of mental disorders (18). For the confirmed and suspected patients, they underwent the fear of the severe consequences and quarantine (19, 20). For the medical service provider, especially those

working on the Covid-19 battlefield, they are at both high risk of Covid-19 infection and mental health problems, as they experience the fear and worry about their own health, and the spreading the virus to their relatives and friends (20). For other people, stressors during quarantine, including fears of infection, boredom and frustration, inadequate supplies, inadequate information and financial loss, contributed to poorer mental health (21). In addition, due to the mandatory quarantine procedures in most of the countries suffering the virus, people, especially for people already living with mental disorder, may experience depression, despair and anxiety (2). According to a previous study including 1,210 participants in China during the period January to February, 54% of respondent reported they suffered moderate to severe psychological impacts from the virus. About one-third of them reported moderate to severe anxiety symptoms, and 17% of them reported obvious depressive symptoms (7). The increased level of anxiety and depression in patients and healthy persons were detected after the stay-at-home order in several countries (22–24). As we do not know how long coronavirus disruptions will last, finding an intervention to prevent or alleviate the psychological impacts is urgently needed.

EXERCISE AS AN INTERVENTION FOR ANXIETY AND DEPRESSION DURING THE COVID-19 PANDEMIC

The effect of exercise in treating or preventing anxiety and depression has been demonstrated in numerous studies (25–27), and widely accepted as an affordable, non-invasive, and easily accessible measures for individual with mental disorders (28, 29). Recently, a study reported that, as people were rarely able to get access to exercise facilities during the Covid-19 pandemic, exergames based on the combination of exercise with appealing digital games was a potential method to cope with anxiety (30). A 20 min single session exergame at moderate intensity were able to significantly reduce the levels of anxiety in healthy person and 8 week exergames performed 2 days per week (60 min *per session*) was demonstrated to alleviate the anxiety levels in patients (30–32). For Covid-19 patients, relaxation techniques and breathing exercises were recommend as one of the interventions to improve acute anxiety, although more evidence is needed (33). Furthermore, a study on college students demonstrated daily physical activity confers beneficial effects in reducing Covid-19-induced stress and anxiety (34).

EFFECTS AND MECHANISMS OF EXERCISE ON DEPRESSION

Depression is one of the most prevalent mental disease affecting around 340 million people all over the world (35), and exert a significant financial and emotional burden to both families and society (36). Patients with depression presented low levels of mood, feelings of guilt, decreased appetite, poor sleep quality, helplessness, low self-worth, fatigue, psychomotor retardation, low interest in social interaction and sexual activity (37). Stressful events from work place and school or abnormal endocrine

function such as hypercortisolism are the common risk factors contributing to depression (38), and about 50% of the depression is determined by gene (37).

Studies on animals demonstrated the beneficial role of exercise on depression depends on the regulation of neurotransmitter, neurogenesis, neurotrophic factors, and cerebral blood flow (Table 1) (51). As reported, exercise could induced the increased level of brain-derived neurotrophic factor (BDNF), which contributed the increased ability against anxiety and depression in mice (52). One of the possible mechanisms was due to the accumulation of an endogenous molecule, D- β -hydroxybutyrate (DBHB), in the hippocampus. The increased DBHB level after long-term exercise could cross the blood brain barriers (BBB) and inhibit class I histone deacetylases, which will specifically improve the expression of BDNF and affect synaptic transmission (52). In a sleep deprivation-induced depression mouse model, exercise was also found to normalize the decreased levels of BDNF, and therefore exert neuroprotective effect and neurotrophic effect (52). In addition, study demonstrated exercise pretreatment could prevent depressive behavior and neurochemical alterations, such as increased levels of norepinephrine (NE), serotonin and its metabolite in the mouse brain, associated with sleep deprivation (42, 44). Furthermore, in a maternal separation-induced depression animal model, the level of 5-hydroxytryptamine (5-HT) and tryptophan hydroxylase (TPH) were decreased in the dorsal raphe. However, treadmill exercise was able to alleviate depression-like behavior through increasing 5-HT and TPH expression (43), and GSK3 β / β -catenin pathway were also believed involved in this process (43). In AD patients, depression is a first sign of cognitive decline at the early stages of AD progression (53). In our previous study, long-term exercise training has been demonstrated as an effective approach to prevent depression in transgenic AD rats, involving the important role of neuroinflammation, oxidative stress, 5-HT and its receptor regulated by exercise training (14). In addition, a well-designed study found transgenic mice with overexpression of muscle PGC-1 α are resilient to stress-induced depression and control plasma and brain kynurenine/kynurenic acid balance, suggesting PGC-1 α -PPAR axis in skeletal muscle as a novel target of exercise in the prevention of depression (14).

Studies on human also provided tons of evidence on the beneficial role of exercise on depression (Table 2) (63–66). In a prospective cohort study, sedentary behavior was positively associated with a higher depression scores at different ages. In contrast, moderate-to-vigorous physical activity were negatively related to symptoms of depression. Therefore, this study suggested that increased light activity and reduced sedentary behavior might contribute to the decreased prevalence of depression (59). Although in another study, there were only small effect in favor of exercise in the inhibition of depression, the small sample size, a high heterogeneity in the participants, interventions and methods of measurement may limit the ability to draw positive results (73). In addition, studies from different countries and regions supported the beneficial of regular exercise on depression. A study including 312 Spanish patients with clinically significant depression over

65 years old reported that at least 60 min daily moderate-intensity regular exercise (muscle strengthening, aerobic exercise, flexibility and balance exercises) could significantly alleviate depression symptoms (60). An 8 year follow-up study in Finland found persons with dyskinesia and a sedentary lifestyle were at higher risk for depression compared with physically active individuals with intact mobility (74). A prospective cohort study from Taiwan reported that three times a week of moderate intensity (at least 15 min per time) continuous exercise could significantly decrease the risk of depressive symptoms, suggesting moderate-intensity regular exercise was beneficial way to improve mental health (61). Furthermore, a study in Myanmar and Vietnam found participant with less sedentary behavior and high physical activity were at lower risk of having depression (62). Depression is also one of the most common complications associated with physical diseases and symptoms (75). For cancer patients, routine care with 40 min per time, three time a week home exercise for 12 weeks significantly reduced the level of depression compared with usual-care group without home-based walking exercise (67). For patients with post-traumatic stress disorder (PTSD), depression is one of the common symptoms (76, 77). Two week fixed bicycle aerobic exercise was able to attenuate PTSD severity and depression symptom (68). According to previous study, depression are very common among the elderly woman, and postmenopausal individuals are vulnerable to depression (78). However, 12 week pedometer-based walking significantly decreased the levels of depression (69). The dysfunction of hypothalamic–pituitary–adrenal (HPA) axis, the increased secretion of corticotropin-releasing hormone (CRH), the impaired responsiveness to glucocorticoids, the increased size and activity of the pituitary were found in patients in depression patients. The ability of exercise on regulating hypothalamo-pituitary adrenal (HPA) axis supported physical exercise may one of the method to improve depression symptoms (79, 80).

EFFECTS AND MECHANISMS OF EXERCISE ON ANXIETY

According to previous studies, nearly one-half of people diagnosed with depression will also experience comorbid anxiety (81). Anxiety is one of the most common mental health diseases contributing to poor concentration, emotional changes, impaired sleep quality and difficulties in performing daily tasks (82, 83). Due to the typical symptoms, including sweating, shaking, chills, rapid heartbeat, poor mental state and hyperventilation, anxiety was defined as a specific psychiatric disorder (37). As reported by previous studies, 25% of the population reported at least one episode of anxiety disorder during their lifetime, and 6% of men and 13% of women suffer from anxiety disorders in the United States (84). Compared with drug therapy, exercise is considered as an alternative therapy for anxiety disorders, which has lower cost and fewer side effects.

Although compared with human studies, preclinical animal anxiety research was limited by animal models and effective

TABLE 1 | Summary of the effect of exercise on anxiety and depression in animal studies.

Study	Condition of interest	Types of exercise	Duration	Outcome	Molecular/cellular
Bjornebekk et al. (39)	Depression	Running wheels	5 weeks	Decreased depressive-like behaviors	Increased cell proliferation
Yau et al. (40)	Depression	Running wheels	14 days	Decreased depression-like behaviors	Neurogenesis
Schoenfeld et al. (41)	Anxiety	Running wheels	5 weeks	Reduces anxiety-like behaviors	N/A
Daniele et al. (42)	Depression	Treadmill	1 h for 8 weeks	Prevents depressive behaviors	Reduce neurochemical alterations
Wang et al. (43)	Anxiety	Treadmill	30 min per day for 10 days	Ameliorate effect on anxiety-like behaviors	GSK3 β / β -catenin
Gokdemir et al. (44)	Depression and anxiety	Treadmill	6 weeks	Decreased anxious-depressive behaviors	Neurogenesis, serotonin, serotonin 1A receptors
Leem et al. (45)	Depression	Treadmill	50 min per day for 4 weeks	Decreased depressive behaviors	Increased neurogenesis via the activation of Wnt/GSK3 β / β -catenin pathway
Agudelo et al. (46)	Depression	Running wheel	8 weeks	Decreased depressive behaviors	PGC-1 α 1-PPAR axis
Wu et al. (14)	Depression and anxiety	Treadmill	45 min per day; 3 times/week for 8 months	Prevents anxious-depressive behaviors	Improves the levels of 5-HT and its receptor; Decreased neuroinflammation and oxidative stress
Park et al. (47)	Depression	Treadmill exercise	30 min at 5 m/min for 15 days	Decreased depressive behaviors	N/A
Motaghinejad et al. (48)	Depression and anxiety	Treadmill forced exercise	45 min/day at 12–13 m/min, for 5 days/week.	Decreased depressive and anxiety level	N/A
Park et al. (49)	Depression	Treadmill exercise	30 min/day at 2 m/minute for 10 day	Alleviated depressive state	Neuronal activation
Patki et al. (50)	Posttraumatic stress disorder	Treadmill exercise	30 min/day at 10–15 m/min for 2 weeks	Decreased depressive and anxiety level	N/A

anxiety tests (85, 86), previous studies suggests that exercise can significantly improve anxiety symptoms (14, 26, 37, 87). The possible underlying possible mechanism may rely on the regulation of hypothalamic-pituitary-adrenal (HPA) axis (88), the upregulation of BDNF (52), the improvement of neurogenesis and angiogenesis (89, 90), and the regulation of inflammatory systems (91). HPA axis dysfunction plays an important role in the onset of anxiety (92). The unexpected or/and long-term stress response along HPA axis is able to induce fear, sympathetic disorder and excessive vigilance, which are closely associated with anxiety (88). However, resistance exercise training was able to regulate cortisol levels, which is one of the functional production of the HPA axis (93, 94). In addition to learning and memory, the hippocampus is also an important brain region involved in social cognition and emotion processing (95). According to previous studies, exercise exerted anti-anxiety effects by improving hippocampal neurogenesis and

normalizing the neurotransmission of neuropeptide Y (NPY) (96). However, more studies on this mechanism are still needed, as other studies found although exercise can improve adult neurogenesis, the new neurons are not involved in the decreased anxiety-like behavior (41). Similar to depression, the decreased BDNF level is a vulnerability factor for anxiety (97). Numerous studies have found that physical exercise can increase the expression of BDNF in the dentate gyrus (98, 99). Although stress-induced increased was able to down-regulate BDNF levels, interestingly, the physical exercise was found to be able to restore BDNF to pre-stress levels, suggesting that exercise protects against stress-induced decreased level of BDNF (93). The regulation of the inflammatory system by exercise is another possible mechanism against anxiety. As reported in previous study, elevated levels of pro-inflammatory cytokine C-reactive protein (CRP) was associated with anxiety disorders (100, 101). Intriguingly, exercise conferred

TABLE 2 | Summary of the effect of exercise on anxiety and depression in human studies.

Study	Condition of interest	Types of exercise	Amount of exercise	Outcome	Effect size
Gong et al. (54)	Prenatal depression	Yoga	12 weeks	Decreased depressive symptoms	Cohen's $d = 0.59$
Maged et al. (55)	Premenstrual Syndrome	Swimming	30 min per time; 3 times/week for 3 months	Decreased depressive and anxiety level	N/A
Wang et al. (56)	Anxiety and stress	Qigong	15–30 min per time; 30 min to 12 weeks	Decreased stress and anxiety level	Cohen's d Anxiety: 0.75 Depression: 0.88
Merom et al. (57)	Depression, anxiety, and stress	Home-based walking program	At least 30 min per week	Decreased depressive, anxiety, and stress level	Cohen's d Depression: 0.36 Anxiety: 0.39
Herring et al. (58)	Anxiety	Resistance or aerobic exercise training	2 weekly sessions	Decreased anxiety symptoms	N/A
Kandola et al. (59)	Depression	Physical activity	Light or moderate-to-vigorous	Attenuated depressive symptoms	Cohen's $d = 0.904$
Lopez-Torres Hidalgo and the DEP-EXERCISE Group (60)	Depression	Aerobic, muscle-strengthening, flexibility, balance-strengthening	At least 30 min; 2 days/week for 6 months	Decreased depressive symptoms	N/A
Chang et al. (61)	Depressive Symptoms	Physical exercise	15 or 30 min per time; 3 or 6 times/week	Decreased depressive symptoms	OR = 0.8, 95% CI 0.66–0.95
Pengpid and Peltzer (62)	Anxiety and Depression	Physical exercise	Low, moderate, and high physical activity	Decreased depressive and anxiety level	N/A
Khanzada et al. (63)	Anxiety and Depression	Regular exercise	N/A	Decreased depressive and anxiety level	N/A
Toups et al. (64)	Major Depression	Walking, jogging, and running	Aerobic exercise	Decreased depressive symptoms	Cohen's d 0.539–0.623
Harvey et al. (65)	Depression	Self-reported exercise types	Regular leisure-time exercise	Decreased depressive symptoms	Odds Ratio: 0.98–1.69
Schuch et al. (66)	Depression	Aerobic exercise	Moderate intensity	Decreased depressive symptoms	SMD = 1.33, 95% CI 0.46–2.19, $P = 0.003$
Chen et al. (67)	Anxiety, Depression	Walking	40 min; 3 times/week for 12 weeks	Decreased depressive and anxiety level	Difference between groups (95% CI) $-0.63 (-20.4, 0.78)$
Fetzner et al. (68)	Posttraumatic Stress Disorder	Stationary biking aerobic exercise	Six sessions for 2 weeks	Reduced anxiety sensitivity	N/A
Abedi et al. (69)	Depression and anxiety	Pedometer-based walking	4, 8, 12 week intervention	Decreased depressive and anxiety level	8th week (4.2 ± 2.1 vs. 5.4 ± 2.3 , $p = 0.007$) 12th week (4.3 ± 2.8 vs. 7.2 ± 2.6 , $p < 0.001$)
Meyer et al. (70)	Major Depressive Disorder	Cycle ergometer	30 min of exercise, either (1) at a moderate intensity or (2) at a preferred intensity	Decreased depressive and anxiety level	Cohen's d 0.365–0.76
Oliveira et al. (71)	Anxiety and depression	Aerobic exercise	12 week intervention	Decreased depressive and anxiety level	Depression: $[4.8(1), p = 0.02, b = 1.6]$; Anxiety: N/A
Yang et al. (72)	Depression	Exercise intervention	70 min for 60 sessions	Decreased depressive level	N/A

its beneficial effect on anxiety by regulating inflammatory systems (91, 102).

Similar to depression, studies on human from different countries showed that exercise could attenuate anxiety behaviors. A study from the United States showed that regular physical activity could significantly reduce the risk of anxiety compared to their sedentary counterparts (103). A study including individuals in the Netherlands reported that moderate exercise has a negative association with anxiety symptoms compared with non-exercisers (104). For healthy people, individuals with a single bouts of physical exercise

have reported less state anxiety, although they did not investigate the effect of accumulated bouts of exercise on anxiety levels (105–107). However, in other interventional studies, researchers found multiple bouts of exercise for 12 months was associated with significant anxiety reduction compared to control group (108). Additionally, different types of exercise on the anxiety reduction were also reported in numerous studies (109). Yoga, an ancient Eastern practice consisting of breath control, physical postures, and meditation, has shown its beneficial effect on patients with severe anxiety symptoms, although the effect was relatively mild (109).

Another study investigating the effect of Tai Chi, a traditional Chinese martial art, on anxiety found that older adults with anxiety receiving medical therapy could benefit from Tai Chi exercise compared with those who only receiving medical therapy (110).

EXERCISE STRATEGIES TO FIGHT AGAINST ANXIETY AND DEPRESSION IN COVID-19 PANDEMIC

The beneficial role of physical exercise has been proved in numerous chronic diseases, including heart disease (111), diabetes (112), asthma (113), back pain (114), arthritis (115), cancer (116), and Alzheimer's disease (13). In addition, as mentioned above, tons of evidence has demonstrated the beneficial role of regular physical exercise on the reduction of anxiety and depression (14, 26, 37, 63–66, 87, 117). Although outdoor physical exercise is unavailable during the outbreak of Covid-19, indoor exercise is recommended in view of the positive effect of exercise on boosting immune system (118–120) and alleviating anxiety and depression (14, 26, 37, 63–66, 87, 117).

According to the information from American College of Sports Medicine (ACSM) (121), World Health Organization (122) and recent literatures about physical exercise during COVID-19 (117), the following exercise strategies were summarized: (1) 150 min moderate-intensity or 75 min vigorous-intensity exercise per week, or perform both of them (or modify according to personal or individual specifications). (2) Home-based exercises including knee-to-elbows, plank, back extensions, squats, side knee lifts, “superman,” “Bridge,” chair dips, chest opener, seated meditation, legs up the wall were recommended. (3) For the outdoor activities allowed by the local government, be active in a local park and keep at least 6 feet distance between you and others. (4) The multi-faceted exercise program is recommended, including aerobic, balance, resistance, coordination and activity training are recommended. (5) Do not use public exercise equipment to avoid virus transmission. Notably, these exercise strategies are recommended for healthy individuals in self-quarantine and cannot replace medical guidance.

Although we believe that home-based exercise best avoids viral transmission, a healthy balance between outdoor and indoor physical activities is optimal when possible. The judgement of where to engage in physical activities should be determined

according to individual's living environment, economic status, health status, and local restrictions.

APPROACHES TO INCREASE PHYSICAL ACTIVITY BEHAVIOR

Although increasing physical activity has demonstrated a beneficial role in fighting anxiety and depression, changing an inactive lifestyle and beginning an exercise regimen is a challenging endeavor for many individuals. According to previous studies, various strategies have been reported as possible approaches to increase physical activity. These include focusing on small quantities of physical activity (e.g., doing exercise during leisure time) (123), improving self-regulation (e.g., learning the benefits of exercise, use of activity trackers to get behavior feedback) (124, 125), strengthening non-conscious processes (e.g., using an enjoyable workout to form an exercise habit) (126), using internet and smartphone apps (127), and increasing accessibility to facilities and environments (e.g., purchasing a treadmill for home use to perform exercise with and compare one's performance with other family members) (125, 128). Also, research suggests a combination of approaches mentioned were better able to lead to improved outcomes (129, 130).

Taken together, the COVID-19 pandemic not only affects physical health, but also mental health (131). Regular physical exercise is for mental health, and able to alleviate the levels of depression and anxiety during COVID-19 pandemic. Staying physically active during the COVID-19 pandemic would contribute to the attenuation of the side effects of COVID-19 on mental health after the pandemic.

AUTHOR CONTRIBUTIONS

SH and LY drafted the manuscript. SH and CW prepared the tables. LY and LT edited and revised the manuscript. All authors approved the final version of the manuscript.

FUNDING

This study was supported by Research Grant 19C0276 from Provincial education department of Hunan, startup funding (18D22) from HengYang Normal University, and Innovation Project of Graduate School of South China Normal University (2018LKXM010).

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Psychological Health Issues Subsequent to SARS-Cov 2 Restrictive Measures: The Role of Parental Bonding and Attachment Style

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OPEN ACCESS

Edited by:

Andreas Maercker,
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Corinne Neukel,
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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 30 July 2020

Accepted: 12 October 2020

Published: 04 November 2020

Citation:

Bussone S, Pesca C, Tambelli R and
Carola V (2020) Psychological Health
Issues Subsequent to SARS-Cov 2
Restrictive Measures: The Role of
Parental Bonding and Attachment
Style. *Front. Psychiatry* 11:589444.
doi: 10.3389/fpsy.2020.589444

Background: The novel coronavirus 2019 (COVID-19) has caused severe panic among people worldwide. In Italy, a nationwide state of alert was declared on January 31st, leading to the confinement of the entire population from March 11 to May 18, 2020. Isolation and quarantine measures cause psychological problems, especially for individuals who are recognized as being vulnerable. Parental bonding and attachment styles play a role in the programming of the stress response system. Here, we hypothesize that the response to restricted social contact and mobility due to the pandemic has detrimental effects on mental-psychological health and that this relationship is, at least in part, modulated by parental bonding and attachment relationships that are experienced at an early age.

Methods: A sample of 68 volunteer University students was screened for psychopathological symptoms (SCL-90-R and STAI-Y), stress perception (PSS), attachment style (RQ), and parental care and overcontrol (PBI) 6 months before the confinement. In the same subjects, psychopathological symptoms and stress perception were measured again during confinement.

Results: Overall, psychological health and stress management deteriorated across the entire sample during confinement. Specifically, a significant increase in phobic anxiety, depression, psychological distress, and perceived stress was observed. Notably, parental bonding and attachment styles modulated the psychological status during the lockdown. Individuals with secure attachment and high levels of parental care (high care) showed increased levels of state anxiety and perceived stress in phase 2, compared with phase 1. In contrast, individuals with insecure attachment and low levels of parental care (low care) already showed a high rate of state anxiety and perceived stress in phase 1 that did not increase further during phase 2.

Conclusion: The general deterioration of psychological health in the entire sample demonstrates the pervasiveness of this stressor, a decline that is partially modulated by attachment style and parental bonding. These results implicated disparate sensitivities to environmental changes in the high- and low care groups during the lockdown, the

former of which shows the greatest flexibility in the response to environment, suggesting adequate and functional response to stress in high care individuals, which is not observable in the low care group.

Keywords: SARS-CoV 2, COVID-19, clinical psychology, SCL-90-R, perceived stress, state anxiety, attachment, parental bonding (PBI)

INTRODUCTION

Responsivity and adaptability to stress are among the main risk factors for psychopathologies. Fundamentally, these mechanisms favor an individual's adaptation to a changing environment, promoting survival (1–3). The stress responsivity system is designed to coordinate responses to psychosocial stressors, filter environmental information to coordinate behavioral responses, and regulate behavioral responses, based on an individual's life history and behavioral repertoire (2). An event can be categorized as stressful when an individual perceives the environmental demands to exceed his adaptive capacity (4). In psychology, perceived stress is a concept connected with the individual's feelings about the general stressfulness of his life and his ability to handle such stress rather than a feeling measuring the frequencies of stressful events that happen to a person. It is generally believed that perceived stress influences both physical and psychological health status (5). Notably, the frequency of serious psychological symptoms, such as depression and anxiety, has been shown to be related either directly (6–8) or indirectly (9, 10) to perceived stress.

Stress reactivity is programmed by early-life experiences (3), such as those that engage motivational systems, such as parental care and attachment (11). Notably, low levels of parental care, reflecting cold, distant parent-child relationships, are associated with a significantly increased risk for depression and anxiety in adulthood [e.g., (12–15)]. Exposure to such adverse environmental conditions at an early age alters the development of the ability to cope with the stress (16). Similar findings have been reported in preclinical studies, in which the centrality of early-life experiences, such as maternal care, in the maturation and development of the behavioral and physiological responsivity to stress, has been postulated (16, 17).

Exposure to epidemics is a stressful event that impacts the entire population. In addition to affecting an individual's physical health, it has many implications for mental health. On an individual level, people experience fear of becoming sick or dying from an epidemic or infectious disease, feelings of helplessness, and stigma under these conditions (18). Moreover, social isolation that is associated with quarantine frequently catalyzes many mental health sequelae (19). However, epidemic-induced stress and psychopathological symptoms are likely to vary among individuals in relation to the individual's ability to cope with stress, an ability derived from early-life experiences such as parental care and attachment. It has been indeed reported that the susceptibility to the development of neuroticism in presence of SARS epidemics was modulated by parental attachment, particularly attachment to the mother (20).

The ongoing COVID-19 pandemic is inducing fear worldwide, and preliminary evaluations and reports on its consequences describe its impact as transversal, affecting anyone (21). Specifically, 25% of the general population has experienced moderate to severe stress- or anxiety-related symptoms in response to COVID-19 (22, 23). Thus, a timely understanding of its impact on mental health is urgently needed (24). Moreover, a recent study describing the modulatory role of attachment styles on psychological distress due to COVID-19 exposure (25), supports the necessity of clarifying the role of attachment and parental care in modulating the physiological and psychological response to this epidemic.

In Italy, a nationwide state of alert was declared on January 31, 2020, leading to the confinement of the entire population from March 11 to May 18, 2020. As a consequence of this pandemic, strict measures of social isolation and social distancing have been implemented.

We hypothesized that the response to the social isolation and restrictive measures due to the COVID-19 pandemic has had detrimental effects on mental health and that the response to this event is, at least in part, modulated by the stressful life events that an individual experienced at an early age, contributing to the development of his ability to cope with stress.

MATERIALS AND METHODS

Participants

Participants included a group of 68 volunteer University students (10 men and 58 women; mean age $\pm$ SE = 2,490 $\pm$ 2,797 years). Prior to enrolment, all participants were given a complete description of the study and signed a written informed consent. The sample was divided into sub-groups according to attachment style measured by Relationship Questionnaire (secure, $N = 24$; insecure $N = 44$) and perceived parental care (low, $N = 21$; high, $N = 24$; intermediate, $N = 23$) and parental control (low, $N = 34$; high, $N = 13$; intermediate, $N = 21$) measured by Parental Bonding Instrument as described in the section below.

The study was approved by the Ethical Committee of the Department of Dynamic and Clinical Psychology, Sapienza, University of Rome (Prot. n. 0000453 and Prot. n. 0000112). None of the subjects received a COVID-19 diagnosis. When asked “who did you spend the quarantine with?” overall, the 13.2% of the sample spent the quarantine with their flat mates, the 16.2% with their partner, the 2% alone, and the remaining 46% with their family.

Clinical Assessment

The online administration of the questionnaires was repeated at two time points (phase): (1) 6 months (on average) before

the COVID-19 pandemic; and (2) during the last weeks of confinement/lockdown in Italy (from April 23 to May 4, 2020). Anamnestic information (about the individual's life conditions), psychopathological symptoms, perceived stress, attachment style, parental care, and parental control measurements were collected on the same subjects, at these time points. At phase 1, the screened sub-groups (secure vs. insecure; high vs. intermediate, and vs. low parental care/control) differed in symptom severity, perceived stress, and state anxiety (**Supplementary Tables 1–4**) measured, respectively by Symptom Check-List-90 item Revised questionnaire, Perceived Stress Scale-10, and State-Trait Anxiety Inventory, as described in the section below.

Symptom Check-List-90 Item Revised (SCL-90-R)

SCL-90-R is a 90-item self-report questionnaire, evaluating psychopathological symptoms and psychological distress in adults from general and clinical populations (26). The SCL-90-R is rated on a Likert scale of 0 (not at all) to 4 (extremely), and asks participants to report if they have suffered in the past week from symptoms of somatization (e.g., headaches), obsessive-compulsivity (e.g., having to check and double-check what you do), interpersonal sensitivity (e.g., feeling that people are unfriendly or dislike you), depression (e.g., feeling blue), anxiety (e.g., feeling fearful), hostility (e.g., having urges to beat, injure, or harm someone), phobic anxiety (e.g., feeling afraid to go out of your house alone), paranoid ideation (e.g., the idea that you should be punished for your sins), and psychoticism (e.g., having thoughts that are not your own). Aside from these nine primary scales, the questionnaire provides a global severity index (GSI), which is used to determine the severity and degree of psychological distress. The SCL-90-R showed good internal coherence ($\alpha = 0.88$) in this study [Italian validated version (27)].

Perceived Stress Scale-10 (PSS)

PSS-10 (5) measures the degree to which one perceives aspects of one's life as uncontrollable, unpredictable, and over-loading. Participants are asked to respond to each question on a 5-point Likert scale ranging from 0 (never) to 4 (very often), indicating how often they have felt or thought a certain way within the past month. Scores range from 0 to 40, with higher composite scores indicative of greater perceived stress. The PSS-10 possesses adequate internal reliability (5) [Italian validated version (6)].

State-Trait Anxiety Inventory (STAI-Y)

STAI-Y (28) consists of 40 statements about the feelings of the participant, divided into two parts. In Part I (20 statements), volunteers are instructed to indicate the intensity of their feelings of anxiety at a moment (state anxiety), using scores ranging from 1 (absolutely not) to 4 (very much). In Part II (other 20 statements), volunteers describe how they generally feel (trait anxiety) by reporting the frequency of their symptoms of anxiety, again using scores ranging from 1 (hardly ever) to 4 (often). The total score of each part may range between 20 and 80, with higher scores indicating higher levels of anxiety. For our aim we used the Part 1 only to assess state anxiety, referring to the transitory emotional response involving unpleasant feelings

of apprehension, tension, nervousness, and worry due to social isolation and the pandemic [Italian validated version (29)].

Relationship Questionnaire (RQ)

RQ (30) was used to measure attachment style. The RQ is a single-item measure made up of four short paragraphs, each describing a prototypical attachment pattern as it applies in close adult peer relationships. Participants are asked to rate their degree of correspondence to each prototype on a 7-point scale. The four attachment patterns (i.e., secure, preoccupied, fearful, and dismissing) are defined in terms of two dimensions: anxiety (i.e., a strong need for care and attention from attachment figures coupled with a pervasive uncertainty about the willingness of attachment figures to respond to such needs) and avoidance (i.e., discomfort with psychological intimacy and the desire to maintain psychological independence). The RQ paragraph describing fearful attachment reads as follows: "I am uncomfortable getting close to others. I want emotionally close relationships, but I find it difficult to trust others completely, or to depend on them. I worry that I will be hurt if I allow myself to become too close to others." A cross-cultural study of the RQ conducted on a convenience sample of college students reported that the mean $\pm$ s.d. score for the Italian population was 3.09 ± 2.01 (31). For our purpose we decided to use the RQ categorically, by dividing the four attachment styles in "secure attachment" and, on the other hand "insecure attachment," which includes fearful, preoccupied and dismissing attachment styles.

Parental Bonding Instrument (PBI)

PBI (13) was used to measure parental care experienced in childhood. The questionnaire is retrospective, meaning that adults (over 16 years) complete the measure for how they remember their parents during their first 16 years. The PBI includes two subscales assessing maternal and paternal care. The participants of this study were assigned to low care or high care groups based on their maternal and paternal care scores, using the suggested cut-off scores by Parker and Lipscombe (32). Individuals who reported scores lower than 27 on PBI maternal care scale and 24 on PBI paternal care scale were classified as low care individuals, whereas the others were considered high care individuals. The requirement of both maternal and paternal care lower than cut-off in the low care group, was chosen in to include only individuals with severe lack of care, while those who received adequate maternal and paternal care were placed in the high care group. Whether one of the parents' care was not adequate, then individuals were included in an intermediate group.

The same group creation criterion was employed for the control dimension, whereas individuals who reported scores lower than 13.5 on PBI maternal care scale and 12.5 on PBI paternal care scale were classified as low control individuals, whereas the others were considered high control individuals. The requirement of both maternal and paternal control higher than cut-off in the high control group, was chosen in to include only individuals who underwent overcontrol during childhood, while those who received adequate maternal and paternal control were placed in the low control group. Whether one of the

parents' control was overt, then individuals were included in an intermediate group of control [Italian validated version (33)].

Statistics

In order to assess the effects of the pandemic on psychopathological and stress-related variables repeated-measures analysis of variance (RM-ANOVA) was performed. Attachment style, parental care and parental control were used as categorical variables, while psychopathological and stress related ones were continuous measures (SCL-90-R subscales score, PSS score, STAI-Y state score). Attachment styles, parental care, and parental control were used as between-subject factors, whereas time as within-subject factors. Significant RM-ANOVAs were followed by *post-hoc* comparisons using either Duncan or Tukey HSD's test. Bonferroni's correction for multiple comparisons was also applied and the significance of the Bonferroni corrected *P*-value was also provided. Statistical analyses were carried out with the help of Statistica software Version 12.0 (StatSoft, Tulsa, OK, USA).

RESULTS

Impact of the COVID-19 Pandemic Due to Confinement, Attachment Style, and Parental Bonding on Psychopathological Symptoms Evaluated by SCL-90-R

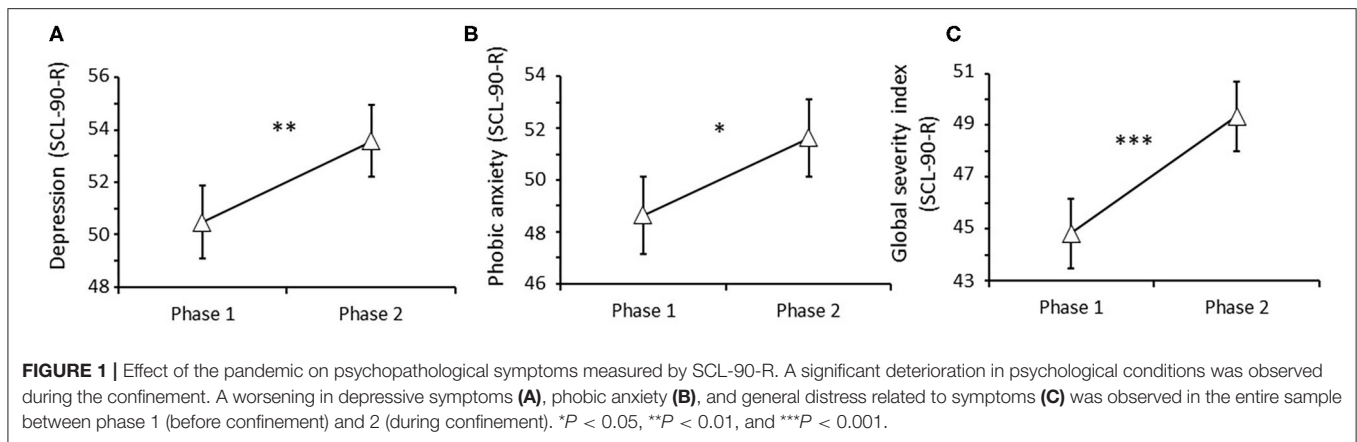
To determine whether the psychological parameters that were measured by SCL-90-R varied between phases 1 and 2, as a result of the restriction of social contact and mobility due to the pandemic, and whether these variations were modulated by attachment style and parental bonding, repeated measure ANOVA was performed for each SCL-90-R subscale.

First, the impact of attachment style, time, and their interaction was analyzed. Attachment style had a significant main effect for the following subscales: somatization [$F_{(1, 66)} = 9.804$, $P = 0.002$; Bonferroni corrected *P*-value = significant, *s*], obsessive-compulsivity [$F_{(1, 66)} = 22.442$, $P < 0.001$; Bonferroni corrected *P*-value = *s*], interpersonal sensitivity [$F_{(1, 66)} = 19.132$, $P < 0.001$; Bonferroni corrected *P*-value = *s*], depression [$F_{(1, 66)} = 21.111$, $P < 0.001$; Bonferroni corrected *P*-value = *s*], anxiety [$F_{(1, 66)} = 10.530$, $P = 0.002$; Bonferroni corrected *P*-value = *s*], hostility [$F_{(1, 66)} = 4.59$, $P = 0.03$; Bonferroni corrected *P*-value = not significant, *ns*], phobic anxiety [$F_{(1, 66)} = 6.04$, $P = 0.02$; Bonferroni corrected *P*-value = *ns*], paranoid ideation [$F_{(1, 66)} = 15.105$, $P < 0.001$; Bonferroni corrected *P*-value = *s*], psychoticism [$F_{(1, 66)} = 18.147$, $P < 0.001$; Bonferroni corrected *P*-value = *s*], and global severity index [$F_{(1, 66)} = 13.770$, $P < 0.001$; Bonferroni corrected *P*-value = *s*]. This effect comprised significantly higher scores for all these parameters in individuals with an insecure attachment style compared with those with secure attachment styles. Specifically, *post-hoc* comparisons performed on values obtained at phase 1 showed significantly higher scores for obsessive-compulsivity, interpersonal sensitivity, depression, anxiety, paranoid ideation, psychoticism, and global severity index in individuals with an insecure attachment style compared with those with

secure attachment styles at this stage (**Supplementary Table 1**). Moreover, time had a significant main effect for depression [$F_{(1, 66)} = 8.959$, $P = 0.004$; Bonferroni corrected *P*-value = *s*], phobic anxiety [$F_{(1, 66)} = 4.698$, $P = 0.03$; Bonferroni corrected *P*-value = *ns*], and the general severity index [$F_{(1, 66)} = 14.258$, $P < 0.001$; Bonferroni corrected *P*-value = *s*], as evidenced by higher scores for these parameters in phase 2 vs. 1 for the entire sample. No attachment style $\times$ time interaction was detected (**Figure 1**; **Supplementary Table 2**).

The impact of parental care, time, and their interaction was also analyzed. A significant main effect of parental care was observed for the following subscales: somatization [$F_{(2, 65)} = 3.435$, $P = 0.04$; Bonferroni corrected *P*-value = *ns*], obsessive-compulsivity [$F_{(2, 65)} = 5.177$, $P = 0.008$; Bonferroni corrected *P*-value = *ns*], interpersonal sensitivity [$F_{(2, 65)} = 7.944$, $P < 0.001$; Bonferroni corrected *P*-value = *s*], depression [$F_{(2, 65)} = 8.325$, $P = 0.003$; Bonferroni corrected *P*-value = *s*], anxiety [$F_{(2, 65)} = 4.204$, $P = 0.02$; Bonferroni corrected *P*-value = *ns*], phobic anxiety [$F_{(2, 65)} = 5.764$, $P = 0.004$; Bonferroni corrected *P*-value = *s*], paranoid ideation [$F_{(2, 65)} = 5.696$, $P = 0.005$; Bonferroni corrected *P*-value = *ns*], psychoticism [$F_{(2, 65)} = 8.455$, $P < 0.001$; Bonferroni corrected *P*-value = *s*], and global severity index [$F_{(2, 65)} = 4.888$, $P = 0.01$; Bonferroni corrected *P*-value = *ns*]. This effect was reflected by significantly higher scores for all these parameters in individuals who received low compared with high and intermediate care. Specifically, *post-hoc* comparisons performed on values obtained at phase 1, showed significantly higher scores for obsessive-compulsivity, interpersonal sensitivity, depression, paranoid ideation, and psychoticism in individuals who received low compared with high care at this stage (**Supplementary Table 3**). Moreover, these comparisons showed significantly higher scores for interpersonal sensitivity, depression, and psychoticism, in individuals who received low compared with intermediate care at phase 1 (**Supplementary Table 3**). No parental care $\times$ time interaction was seen.

Finally, the impact of parental control, time, and their interaction was examined. Parental control had a significant main effect for the following subscales: somatization [$F_{(2, 65)} = 3.22$, $P = 0.04$; Bonferroni corrected *P*-value = *ns*], interpersonal sensitivity [$F_{(2, 65)} = 9.263$, $P < 0.001$; Bonferroni corrected *P*-value = *s*], depression [$F_{(2, 65)} = 6.714$, $P = 0.002$; Bonferroni corrected *P*-value = *s*], phobic anxiety [$F_{(2, 65)} = 6.725$, $P = 0.002$; Bonferroni corrected *P*-value = *s*], paranoid ideation [$F_{(2, 65)} = 6.367$, $P = 0.002$; Bonferroni corrected *P*-value = *s*], and psychoticism [$F_{(2, 65)} = 4.125$, $P = 0.02$; Bonferroni corrected *P*-value = *ns*]. This effect consisted of significantly higher scores for these parameters in individuals who experienced high vs. low and high-low parental control. Specifically, *post-hoc* comparisons performed on values obtained at phase 1, showed significantly higher scores for interpersonal sensitivity, depression, phobic anxiety, paranoid ideation, and psychoticism in individuals who received low compared with high control at this stage (**Supplementary Table 4**). Moreover, these comparisons showed significantly higher scores for interpersonal sensitivity in individuals who



received high compared with intermediate control at phase 1 (Supplementary Table 4). No parental control $\times$ time interaction was observed.

Impact of COVID-19 Pandemic Due to Confinement, Attachment Style, and Parental Bonding on Perceived Stress Evaluated by PSS

Repeated measure ANOVA was performed to determine whether perceived stress, as measured by the PSS, differed between phases 1 and 2 and whether these variations were modulated by attachment style, parental care and parental control.

First, the impact of attachment style, time, and their interaction was analyzed. We noted a significant main effect of attachment style [$F_{(1, 66)} = 15.042$, $P < 0.001$; Bonferroni corrected P -value = s], reflected by significantly higher PSS scores in individuals with an insecure vs. secure attachment style. Specifically, *post-hoc* comparisons performed on values obtained at phase 1, showed similar differences between groups at this stage (Supplementary Tables 1, 2). Moreover, time had a significant main effect [$F_{(1, 66)} = 5.266$, $P = 0.025$; Bonferroni corrected P -value = ns], consisting of higher PSS in phase 2 compared with phase 1 in the entire sample (Figure 2A). No significant attachment style $\times$ time interaction was detected.

Further, the impact of parental care, time, and their interaction was studied. There was a significant main effect of parental care [$F_{(2, 66)} = 9.248$, $P < 0.001$; Bonferroni corrected P -value = s], consisting of significantly higher PSS scores in individuals who received low vs. high or intermediate care. Specifically, *post-hoc* comparisons performed on values obtained at phase 1, showed similar differences among groups at this stage (Supplementary Table 3). Moreover, a significant interaction between parental care and time was also observed [$F_{(2, 65)} = 3.243$, $P = 0.045$; Bonferroni corrected P -value = ns], with only individuals who received high care showing a significant increase in PSS between phases 1 and 2 (Figure 2B).

Finally, the impact of parental control, time, and their interaction was analyzed. This analysis revealed a significant main effect of parental control [$F_{(2, 65)} = 5.600$, $P = 0.006$; Bonferroni corrected P -value = ns], comprising significantly

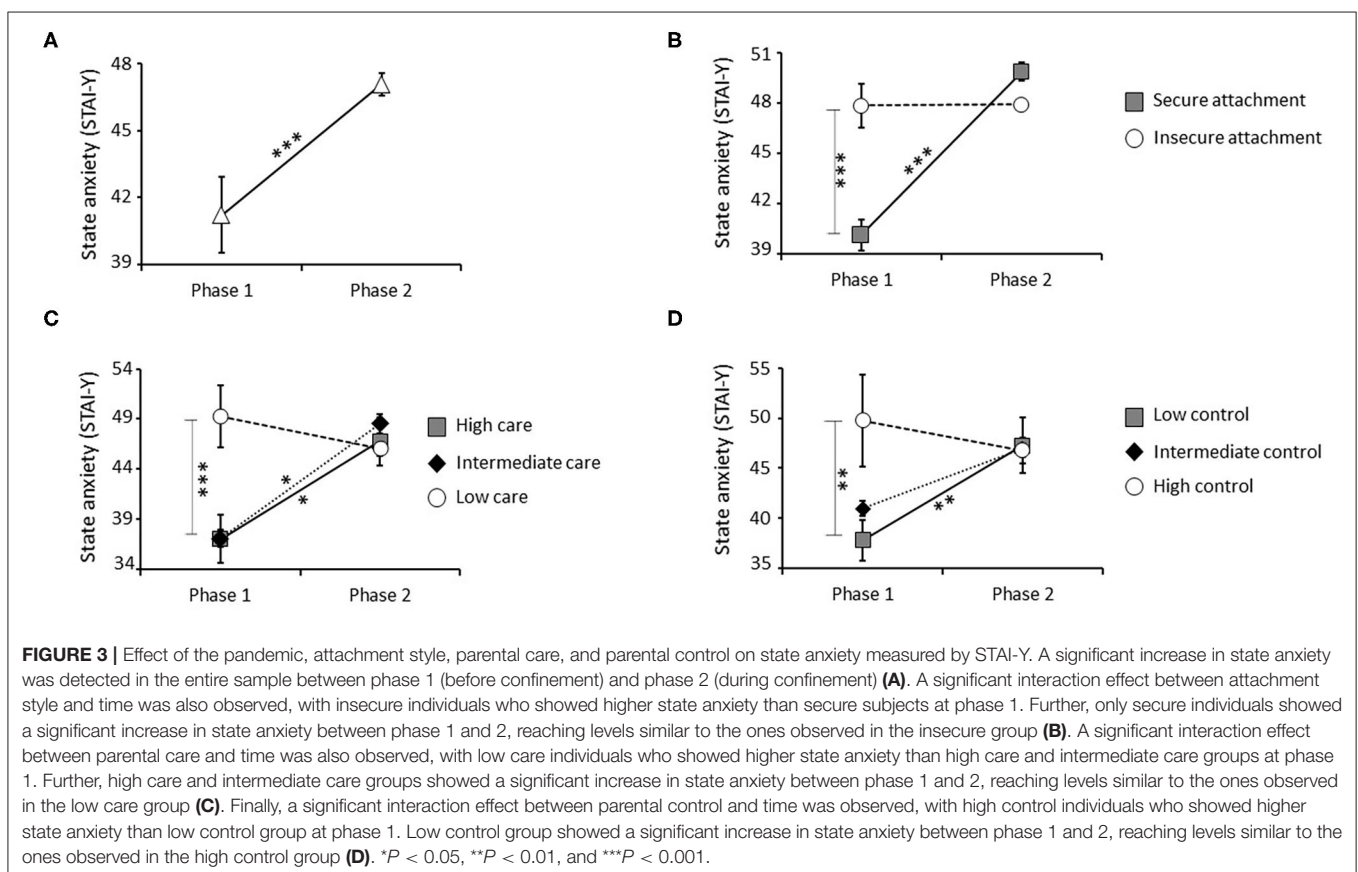
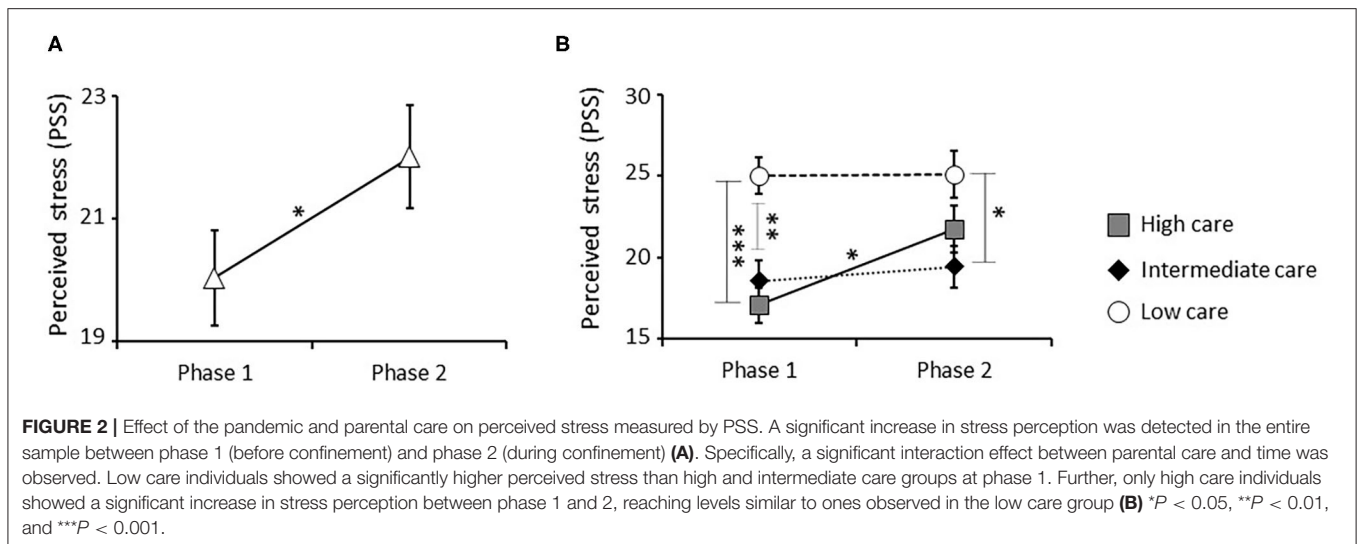
higher PSS scores in individuals who received high vs. low control. Specifically, *post-hoc* comparisons performed on values obtained at phase 1, showed similar differences among groups at this stage (Supplementary Table 4). No significant effect of the parental control $\times$ time interaction was seen.

Impact of COVID-19 Pandemic Due to Confinement, Attachment Style, and Parental Bonding on State Anxiety Evaluated by STAI-Y

To determine whether state anxiety, as measured by the STAI-Y, changed between phases 1 and 2 and whether these variations were modulated by attachment style, parental care, and parental control, repeated measure ANOVA was performed.

First, the impact of attachment style, time, and their interaction was analyzed. This analysis revealed a significant main effect of attachment style [$F_{(1, 60)} = 9.569$, $P = 0.003$; Bonferroni corrected P -value = s], consisting of significantly higher state anxiety in individuals with insecure vs. secure attachment styles. Specifically, *post-hoc* analyses performed on values obtained at phase 1, showed similar difference between groups at this stage (Supplementary Tables 1, 2). Moreover, a significant main effect of time [$F_{(1, 60)} = 22.256$, $P < 0.001$; Bonferroni corrected P -value = s] was seen, based on higher levels of state anxiety in phase 2 compared with phase 1 in the entire sample (Figure 3A). A significant effect of the attachment style $\times$ time interaction was also detected [$F_{(1, 60)} = 21.583$, $P < 0.001$; Bonferroni corrected P -value = s], with only individuals with secure attachment showing a significant increase in state anxiety in phase 2 with respect to phase 1. As result of this effect, individuals with secure attachment did not differ from those with insecure attachment for this parameter in phase 2 (Figure 3B).

The influence of parental care, time, and their interaction was analyzed. Parental care had a significant main effect [$F_{(2, 59)} = 6.163$, $P = 0.004$; Bonferroni corrected P -value = s], consisting of significantly higher state anxiety in individuals who received low vs. high and intermediate care. Specifically, *post-hoc* comparisons performed on values obtained at phase 1, showed similar difference among groups at this stage (Supplementary Table 3). A significant interaction effect between parental care and time



was also observed [$F_{(2, 59)} = 6.822$, $P = 0.002$; Bonferroni corrected P -value = s], with individuals who received high and intermediate care showing a significant increase in state anxiety between phases 1 and 2. No difference between phases 1 and 2 was noted in individuals who received low parental care (Figure 3C).

Finally, the impact of parental control, time, and their interaction was analyzed. Parental control had a significant

main effect [$F_{(2, 59)} = 4.331$, $P = 0.02$; Bonferroni corrected P -value = ns], reflected by significantly higher state anxiety in individuals who experienced high compared with low control. Specifically, *post-hoc* comparisons performed on values obtained at phase 1, showed similar difference among groups at this stage (Supplementary Table 4). Finally, a significant parental control $\times$ time interaction effect was observed [$F_{(2, 59)} = 3.341$, $P = 0.04$; Bonferroni corrected P -value = ns] with individuals who

received low or intermediate control showing significantly higher state anxiety between phases 1 and 2. No difference between phases 1 and 2 was seen in individuals who received high levels of parental control (**Figure 3D**).

DISCUSSION

This report is the first study to evaluate the impact of the COVID-19 pandemic on psychological symptoms in subjects who were psychometrically screened 6 months before restrictive measures were applied to contain it and at the end of this restriction period. This longitudinal experimental design allowed us to directly assess the effects of COVID-19 on mental health status and its correlates on the same subjects.

Moreover, a cross-cutting effect of the restrictive measures and the pandemic itself was noted. In particular, an increase in depressive symptoms, phobic anxiety, and general distress in relation to the symptoms themselves was detected in our sample during the lockdown. Moreover, greater perceived stress and state anxiety were observed. Consistent with these results, previous studies have shown that epidemics have detrimental effects on general mental health status (34, 35). During epidemics that have required quarantine measures, psychopathological manifestations have arisen, such as post-traumatic symptoms that belong to the symptomatological core in our study, as well as depressive, anxiety, and panic symptoms (34). Increased levels of depression, anxiety, and general distress were reported during the previous SARS outbreak (36) and other epidemics, such as swine flu and avian influenza (36). In line with these studies, evolutionary explanations show how the increased fear and emotional reactivity due to epidemics was selected by the natural selection in order to minimize infection risk (37).

Preliminary population studies have described similar results during the COVID-19 pandemic, with a wide presence of mood symptomatology (e.g., depression and anxiety) and phobia [for a review, see (38–40)]. Similarly, increased hostility, stress perception, and psychological distress have been reported (41).

In addition to the effects of the restrictive measures, we observed a significant effect of attachment style and parental care and control on psychopathological symptoms, perceived stress, and state anxiety parameters, with individuals with insecure attachment, low care, and high control exhibiting high scores on these scales. This effect was already visible at phase 1 and remained stable between phase 1 and phase 2 of the study in this group. However, the mean values obtained from this group were below the maximum scores that can be obtained on these scales (usually observable in clinical samples) excluding therefore the possibility of being in presence of a ceiling effect in these individuals. Overall, these results are consistent with the vast literature on the modulating effects of attachment style and parental care and control on the dimensions on several psychopathological traits, perceived stress, and state anxiety (42–47), again supporting the relevance of these events in psychopathological outcomes.

A notable aspect of this study was its detection of an interaction effect between attachment, parental bonding and confinement on perceived stress and state anxiety parameters. Specifically, we demonstrated that individuals with secure attachment, high parental care, and low control suffered more from the effects of confinement than their counterparts, who instead remained steadily high in terms of perceived stress and state anxiety between the first and second phases of the study. One interpretation of this result is that the lockdown/confinement was not stressful enough to increase stress perception and state anxiety in insecure, low care individuals, who are accustomed to dealing with large amounts of socio-relational stress.

Another explanation, connected in part to the previous hypothesis, attributes the absence of an effect of the confinement measures in the insecure, low care group to “malfunction” of their stress response system, which when well-functioning in secure, high care subjects elicits increased perceived stress and state anxiety under such stressful conditions. Support for this hypothesis comes from studies that have consistently reported psycho-pathological symptoms in individuals who have experienced low levels of parental care and/or dysfunctional parent-child attachment at an early age (44–46). This ability to cope with environmental changes is pivotal for an individual's survival and matures as a result of the events that are experienced at an early age (48, 49). These results implicate disparate sensitivities to environmental changes in the high- and low care groups during the lockdown, the former of which shows the greatest flexibility in the response to environmental stimulation, suggesting adequate ability to cope with stress in high care individuals, which is not observable in the low care group.

This study has several limitations: (1) few subjects were enrolled, and (2) the sample was mainly composed of female students, and this reduces the generalizability of our results to the general population. About the low number of subjects we want to underline that as being a longitudinal study comparing the first phase, 6 months before COVID-19 pandemic, with the second phase, during the COVID-19-due confinement, we could not decide the number of subjects to test because of the unpredictability of the pandemic. The low number of subjects partially influenced the low *p*-value significance obtained in our study, and some results were not significant after Bonferroni correction for multiple testing. However, although we decided to provide *p*-value significance with and without Bonferroni correction in the manuscript, we kept discussing and presenting our results as significant considering the *p*-value without Bonferroni correction. This has been done considering that the results obtained from this longitudinal study are extremely relevant to understand the psychological consequences of being exposed to COVID-19-due confinement, although the obtained data do not meet a statistical precision criterion due to the aforementioned limitations.

Our results obtained raise 3 notable questions that warrant further investigation: (1) Does the psychological suffering in the entire sample (depressive, phobic anxiety, and hostility symptoms) return to normal levels after suspension of the confinement, or does this event induce a more structured disease?

(2) Does perceived stress and state anxiety levels in secure, high care individuals return to normal levels after suspension of the confinement? (3) Is it possible that insecure, low care individuals, although they do not exhibit increased perceived stress and state anxiety during confinement, develop this symptomatology several weeks after the end of confinement, supporting the hypothesis of a delayed coping response than in the absence of such a response?

Future longitudinal studies should address these questions to determine the need for psychological interventions in mitigating the psychological impacts of this pandemic.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethical Committee of the Department of Dynamic and Clinical Psychology, Sapienza University of Rome. The patients/participants provided their written informed consent to participate in this study.

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AUTHOR CONTRIBUTIONS

SB and CP collected the data. SB and VC analyzed the data and designed the figures. SB, RT, and VC wrote the manuscript. All authors contributed to the article and approved the submitted version.

FUNDING

This work was supported by Sapienza University—2019 Research Grant No. RG11916B50652E41 (to VC).

ACKNOWLEDGMENTS

The authors thank Prof. Cristina Trentini for critically reading the manuscript. The professional editorial work of Blue Pencil Science was also acknowledged.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2020.589444/full#supplementary-material>

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The Influence of the COVID-19 Pandemic on Mental Well-Being and Psychological Distress: Impact Upon a Single Country

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OPEN ACCESS

Edited by:

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University of Zurich, Switzerland

Reviewed by:

Sandy Patsch-Krammer,
University of Bern, Switzerland
Gianluca Serafini,
San Martino Hospital (IRCCS), Italy

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 12 August 2020

Accepted: 14 October 2020

Published: 11 November 2020

Citation:

Gray NS, O'Connor C, Knowles J, Pink J, Simkiss NJ, Williams SD and Snowden RJ (2020) The Influence of the COVID-19 Pandemic on Mental Well-Being and Psychological Distress: Impact Upon a Single Country. *Front. Psychiatry* 11:594115. doi: 10.3389/fpsy.2020.594115

The COVID-19 pandemic is likely to have affected the psychological well-being and mental health of many people. Data on prevalence rates of mental health problems are needed for mental health service planning. Psychological well-being and prevalence of clinically significant mental distress were measured in a large sample from Wales 11–16 weeks into lockdown and compared to population-based data collected in 2019 before the COVID-19 pandemic. Data were collected using an online survey disseminated across Wales and open to adults (age 16+) from 9th June to 13th July 2020. Psychological well-being was indexed via the Warwick-Edinburgh Mental Well-being Scale, and psychological distress was indexed via the K10. Data from 12,989 people who took part in this study were compared to that from April 2018 - March 2019, gathered by the National Survey for Wales ($N = 11,922$). Well-being showed a large decrease from 2019 levels. Clinically significant psychological distress was found in around 50% of the population (men = 47.4%, women = 58.6%), with around 20% showing “severe” effects (men = 17.0%, women = 20.9%): a 3–4-fold increase in prevalence. Most affected were young people, women, and those in deprived areas. By June–July 2020 the COVID-19 pandemic had dramatic effects on the mental health of people living in Wales (and by implication those in the UK and beyond). The effects are larger than previous reports. This probably reflects that the current data were taken deeper into the lockdown period than previous evaluations. Mental health services need to prepare for this wave of mental health problems with an emphasis on younger adults, women, and in areas of greater deprivation.

Keywords: mental health, psychological well-being, psychological distress, COVID-19, mental disorder, K10, Warwick Edinburgh Mental Well-being Scale (WEMWBS)

INTRODUCTION

The COVID-19 pandemic has caused widespread problems across the world that are likely to have adverse effects on mental health and well-being (1, 2). The problems are multifarious and include fear of one's own illness or death, fear of illness or death of a loved one, fears due to loss of employment, and the effects of social and physical isolation in response to the pandemic (3).

Early reports showed that care-workers suffered from high rates of depression and anxiety during the first few weeks of the initial outbreak in China, with women being particularly affected (4). However, as Perlis (5) notes, this leaves open many questions, such as whether these rates are due to being a health-care worker, simply living in the midst of such an outbreak, or due to the possible consequences of quarantine or other restrictions. Perlis (5) also raises the issue of whether these symptoms will persist or even worsen over time.

There have now been several reports on the mental health of specific populations during the COVID-19 pandemic. McGinty et al. (6) sampled over 1,000 individuals from the USA in a single week in April 2020 and compared this to a national sample taken during 2018. Using the K6 (7) measure of psychological distress, they noted that 13.6% reported “serious” levels of psychological distress during the pandemic period compared to 3.9% in 2018. These levels were moderated by age and income, with 18–29 year olds having a prevalence of 24.0% and those with the lowest income having a prevalence of 19.3%. Pierce et al. (8) studied 17,000 individuals across the UK in a single week in April 2020 (1 month into the COVID-19 lockdown) and compared this with previous data. Using the GHQ-12 (9), a measure of mental health relative to the person’s usual mental state, they found a modest increase in GHQ-12 scores that corresponded to an increase in psychological distress from 18.9% pre-COVID-19 to 27.3%. These increases were greater in the younger age groups, and for women. This pattern of results has been replicated by other studies that occurred in the early phase of the pandemic [e.g., (10–12)] and have been extended to show high levels of thoughts of self-harm and suicide in the first month of the lockdown in the UK (13) with, again, a higher incidence rate for women.

There are also an increasing number of yet-to-be peer-reviewed reports that attest to deterioration of mental health due to the COVID-19 pandemic (14–24). However, the current report does not provide an in-depth review of this material due to concern expressed by others (25, 26) that some of these data may be misleading due to not having been appropriately peer-reviewed.

The present study examined psychological well-being and mental distress in the population of Wales during the period of lockdown, and took measures of key demographic variables that might moderate these effects. The study adds to previous studies in several ways. First, data was taken for both psychological well-being and psychological distress. These concepts are distinct, but correlated, and are not merely the inverse of each other. Well-being represents feelings of happiness and a sense of purpose which can remain even in the presence of mental illness, distress, or suffering (27–29). So far, there have been no studies examining the effects of the COVID-19 pandemic on mental well-being.

Second, the present study examined a period deeper into the pandemic. For instance, most studies (4, 6, 8, 10–12) gathered data within the first few weeks of the pandemic, whereas the data for the present study were gathered 11–16 weeks into the lockdown period. It is possible that psychological well-being will be more severely impacted after a prolonged exposure to pandemic related stressors. For example, Kato et al. (30) argued that longer lasting social isolation increases loneliness and that

loneliness is, in turn, a crucial risk factor for a number of forms of mental health difficulty, including anxiety, depression and addiction disorders. Alternatively, it is possible that people will learn and adjust to the situation over time and that the psychological stress caused by the pandemic diminishes over time—see Perlis (5). This is an empirical argument and it is important to evaluate the strength of these effects.

Third, studies such as Pierce et al. (8) used a measure of mental health that uses the person’s usual mental health as a baseline. Hence, a person who is only mildly distressed relative to their normal healthy state will score higher on the GHQ-12 than someone who remains in a chronic state of severe distress or mental illness. While the GHQ-12 excels in examining changes in mental health, it is less able to gauge the absolute levels of well-being or mental health in the population. The K10 (7) is better placed to do this as it asks for frequency of symptoms and is designed to classify individuals into categories of psychological distress (none, mild, moderate, or severe).

The first COVID-19 case was confirmed in Wales on the 28th February 2020 with the first death reported on the 16th March 2020. By 20th March 2020 all mainstream schools across Wales were closed. On March 23rd 2020 the UK Government issued a lockdown of the UK and only essential services remained open. Gatherings of two or more people (except for individuals in the same household) were banned, whilst pubs, restaurants, and shops selling “non-essential goods” were ordered to close. Individuals in Wales were informed they could no longer travel more than 5 miles from their home unless necessary.

At the start of the present survey (9th June 2020), the UK had the second highest number of cumulative deaths in the world, only surpassed by the USA (31). At this point, over 9% of all reported deaths resulting from COVID-19 had occurred in the UK. Of a total 39,277 deaths, 1,435 deaths had occurred in Wales, a rate of 45.5 deaths per 100,000 people (32, 33). During the period of the survey, reported deaths from COVID-19 continued to increase. On the 6th July 2020 lockdown restrictions began to ease in Wales so that people were now allowed to travel more than 5 miles, although the other restrictions remained in place.

By the end of the survey (13th July 2020), the UK had the third highest death toll from the pandemic (30), having reported another 1,711 deaths during this period. During this period, the mortality rate increased further in Wales, to 49.0 deaths per 100,000 people (31, 32). Restrictions were eased further on the 31st July 2020. Pubs and restaurants were able to open indoor areas on 3rd August 2020. Up to 30 could meet outdoors, and children under 11 would no longer have to socially distance. Swimming pools, gyms, leisure centers and indoor play areas were allowed to reopen from 10th August 2020, but all with social distancing measures in place.

Objectives

The main objective of the study was to measure the psychological well-being of the Welsh population during a period 11–16 weeks into the period of lockdown due to the COVID-19 sample and compare this to levels in a period before the lockdown. In addition, it aimed to examine the prevalence of

significant levels of psychological distress during the COVID-19 lockdown. In addition, the study looked at factors that might mitigate or aggravate such distress. We hypothesized that psychological well-being would be reduced due to COVID-19 and that this effect would be greater in women than in men, in those of a younger age, and in those people living in areas of high deprivation (8). In line with this reduction in psychological well-being, we hypothesized that levels of mental distress would be high, with the same demographic factors aggravating these levels of distress (6, 8, 10–12).

MATERIALS AND METHODS

The study was approved by the Research Ethics Committee at the College of Health and Human Sciences, Swansea University. The project is registered with ISRCTN ref: 21598625. The study protocol is published at: <https://www.swansea.ac.uk/psychology/research-at-the-department-of-psychology/research-protocols/>.

With respect to mental health, it is important to compare the situation during the lockdown period to data from before this period in order to gauge the effects of the pandemic. The National Survey for Wales (NSfW) performs regular surveys of the Welsh population and had data on mental well-being from 11,922 respondents during the period April 2018 to March 2019 (34). We will term this as the “2019 sample.” Therefore, the present study (which we will term the “2020 sample”) used the same measure of mental well-being, the Warwick-Edinburgh Mental Well-being scale [WEMWBS (28)], in order to be able to compare the 2020 sample to this 2019 sample.

Participants

Participants for the 2020 sample were recruited *via* online snowball sampling. The survey was advertised *via* a programme of social media advertisements and emails designed to cover the population of Wales. This included emails and tweets being sent to organizations across Wales asking them to publicize the existence of the survey to their staff and service-users and giving the URL of the survey website to be able to access the survey. Many organizations agreed to support the research and to advertise and disseminate the survey (see Acknowledgments). This included all seven Health Boards in Wales; the four police forces in Wales; the Welsh Ambulance Service Trust; the Fire & Rescue Service; many large employers across Wales, including large government organizations; care homes for elderly residents; homelessness organizations; GPs; the Welsh Farmers' Union; and third sector partnership organizations (e.g., charitable organizations supporting specific sectors of the community). The survey was also advertised *via* newspapers, radio programmes, and celebrity tweets.

In order to match the 2020 sample to the 2019 sample (34), the 2020 sample recruited a minimum number ($n = 250$) from each of the 22 Local Authorities across Wales. This also ensured good coverage of all seven Health Boards across Wales.

Data for the 2019 sample were taken from the National Survey for Wales (NSfW) conducted between April 2018 to March 2019 (34). This is a large-scale survey of adults in Wales run by the Office for National Statistics on behalf of the Welsh Government.

Twenty thousand participant households in Wales were chosen at random from the Royal Mail's publicly available address list and were invited to take part. Face to face interviews were conducted on 11,922 participants. Information was collected on several topics including population health and well-being, children and education and social care services. The survey aimed to gather an understanding of life across Wales, and the results are used by the Welsh Government to assist in policy and decision making and directing resources to where they are needed the most.

Procedures

The survey was open from 9 June 2020 to 13 July 2020. The survey was administered online (Qualtrics software, Version June 2020, Provo, UT, USA, Copyright © 2020Version) for the vast majority of participants (>99%), and was available in both English and Welsh language versions.

The survey also had a dedicated telephone line that was widely advertised so hard to reach sectors of the population without access to the internet or electronic devices could request a paper-based survey (with stamped addressed envelope) and thus were able to engage with the survey. The survey was designed to take around 10 min to complete (see Results).

Measures

The survey comprised various sections. The first section was an information sheet and informed consent form. The next section asked demographic questions that included gender, age group, ethnicity, occupation, and postcode (used to calculate the deprivation index) among others. The next section covered the person's current thoughts and feelings and included both the WEMWBS and the K10 (see below). The next section looked at the person's current stressors and their resilience to stress in order to examine what aspects of the pandemic were related to poor psychological well-being and whether there were personal factors that might mitigate against poor psychological well-being. The final section examined if there were aspects of the lockdown that people had enjoyed during the pandemic (e.g., spending more time with their family), in order to examine if there are positive factors that mitigate against poor psychological well-being due to the pandemic. Given the large dataset generated, data from these final two sections were not analyzed here and so the details are not provided. We hope to disseminate these data at a later date.

In accordance with recent ethical considerations for mental health research during the COVID-19 pandemic (35), participants were informed that the study would ask questions about their emotional well-being before they were asked to provide fully informed consent. Further, as suggested by Townsend et al. (35) there was a section at the end of the survey that attempted to mitigate any distress caused by the survey. This section asked participants to consider whether there were any aspects of the COVID-19 pandemic that they had enjoyed (e.g., “spending more time with one's family” or “enjoying a renewed sense of community spirit”). At the end of the study, participants were also provided with a debrief form that thanked them for their important role in the research and then signposted to three separate services, available across Wales, that offered free, 24/7, confidential listening and support *via* the telephone, SMS

messaging or e-mail. Participants were encouraged to contact the provided services if they were experiencing any current emotional difficulties.

Mental Well-Being

Current mental well-being (over the past 2 weeks) was assessed via the Warwick-Edinburgh Mental Well-being Scale [WEMWBS (28)]. The WEMWBS has been used in studies across the world [e.g., (36)]. It has strong positive relationships to other measures of positive mental health (28, 37). However, it has a more modest negative relationship to measures of mental ill-health (e.g., GHQ-12) suggesting that the two concepts are not merely the inverse of each other (27, 28).

The WEMWBS contained 14 items covering issues such as positive affect, level of functioning, and relationships over the past 2 weeks. Items are answered on a five-point Likert scale with respect to frequency (from “none of the time” to “all of the time”) to give a score ranging from 14 to 70, with greater scores indicating greater well-being. The internal consistency of the WEMWBS was high in the 2020 sample (Cronbach $\alpha = 0.94$).

Psychological Distress

Current level of psychological distress was assessed by the Kessler Distress Scale [K10: (7)]. The K10 has been used in studies across the world (35, 38, 39) and is available in several languages [e.g., (40, 41)]. It has good ability to predict serious mental illnesses in the general population (41–43).

The K10 contains 10 items measuring current psychological distress, and, in particular, symptoms of anxiety and depression. Items are rated on a five-point Likert scale with respect to frequency (from “none of the time” to “all of the time”) to give a score from 10 to 50, with greater scores indicating greater levels of psychological distress. The standard K10 asks people to rate their distress over the past 30 days. However, this was amended to cover the past 2 weeks to match the time period of the WEMWBS. The internal consistency of the K10 was high in the 2020 sample (Cronbach $\alpha = 0.93$).

Welsh Index of Multiple Deprivation

The Welsh Index of Multiple Deprivation (WIMD) is produced by the Welsh Government (44) and is a measure of relative deprivation for 1909 areas of Wales (1 = most deprived, 1,909 = least deprived) each containing an average of 1,600 people. It assesses deprivation as “the lack of access to opportunities and resources which we might expect in our society” (44). It also has an interactive tool that allows for a postcode to be translated into the WIMD rank.

RESULTS

Demographics

In total, 15,469 people started the survey. Of these, 2,417 did not complete over 50% of the survey (this corresponds to not having completed the WEMWBS, which was the primary outcome measure) and were excluded from further analysis. We do not have any information on the reason(s) behind these individuals not completing the survey.

Analysis of the time taken to complete the survey found that the median time was 647 s (IQR: 510–863) and people ($n = 63$) who had taken <240 s were removed as we judged that such

TABLE 1 | Demographic information on the sample and that of the NSW (34).

		Number	Percent	NSW 2019
Total		12989		
Gender	Male	2490	19.2	44.9
	Female	10391	80.0	55.1
	Other	25	0.2	–
	Prefer not to say/no response	83	0.6	0.0
Age	16–24	703	5.4	5.8
	25–34	1870	14.4	11.9
	35–44	2647	20.4	13.0
	45–54	3254	25.1	15.6
	55–64	2761	21.3	18.2
	65–74	775	6.0	19.9
	75+	968	7.5	15.6
	Prefer not to say/no response	11	0.1	0.0
Ethnicity	White—any	12553	96.6	96.4
	Asian—any	130	1.0	1.7
	Black—any	16	0.1	0.5
	Mixed—any	110	0.8	0.5
	Other	74	0.6	0.8
	Prefer not to say/no response	106	0.8	0.1
Relationship status	Single	1847	14.2	28.4
	Married/civil partnership	7101	54.7	45.2
	Co-habiting	1880	14.5	–
	Partner non-cohabiting	753	14.2	–
	Separated	198	1.5	2.4
	Divorced	652	5.0	11.8
	Widowed	406	3.1	12.2
	Other	69	0.5	–
	Prefer not to say/no response	83	0.6	0.1
Employment	Paid employment	8533	65.7	46.3
	Self-employed	502	3.9	
	Student	480	3.7	3.7
	Apprentice	31	0.2	–
	Unemployed	149	1.1	2.1
	Long term sick/disability	413	3.2	5.5
	Retired	1945	15.0	36.6
	Furloughed	574	4.4	–
	Stay at home parent	228	1.8	4.7
	Full time carer	42	0.3	
	Other	2	0.0	0.8
	Prefer not to say/no response	90	0.7	0.0

fast completion was not commensurate with carefully answering the questions. Hence, data from 12,989 people are reported, although not all people completed all sections or all questions. Numbers of people involved in each analysis are stated in the appropriate place.

Demographic data from the 2020 sample are displayed in **Table 1**, alongside data from the 2019 sample. The majority of respondents classified themselves as “White” with other categories making up <4%. This was highly similar to the 2019 sample that was itself representative of the population of Wales (34). The 2020 sample showed a gender imbalance (~80% women) which is not representative of the population. Hence, all statistical analyses were stratified by gender so that any differences due to gender would not affect the results reported. Our sample also showed an under-representation of older adults compared to the 2019 sample.

Well-Being Index

Data from the 2020 sample ($n = 12,554$), stratified by gender and age-group, are displayed in **Figure 1** (filled symbols). An analysis of variance (ANOVA) showed a small effect of gender, $F_{(1, 12,540)} = 46.45$, $p < 0.001$, $\eta_p^2 = 0.004$, such that men reported higher well-being scores than women ($M = 46.3$ [95% CI: 45.8, 46.7] vs. 44.5 [44.3, 44.8]). There was a main effect of age, $F_{(6, 12,540)} = 68.12$, $p < 0.001$, $\eta_p^2 = 0.032$, such that well-being increased with increasing age (e.g., 16–24 year olds $M = 42.4$ [41.5, 43.3]; 75+ year olds $M = 50.3$ [49.6, 51.0]). The interaction between gender and age was not significant.

Data from the 2019 sample ($n = 9,753$) are also plotted in **Figure 1** (open symbols). Scores for the 2020 sample were

significantly lower than for the 2019 sample, $F_{(1, 22,279)} = 1,215.12$, $p < 0.001$; $\eta_p^2 = 0.05$ ($M = 45.4$ [45.2, 45.6] vs. $M = 51.1$ [50.9, 51.3]). The data from the 2019 sample were taken across a year-long period, whereas the 2020 sample were taken in the months of June and July. To account for possible time of year effects, we examined the 2019 data by month. In the months of June and July the mean WEMWBS was 51.4 [50.7, 52.0] which was slightly above the mean for the year ($M = 51.2$ [51.1, 51.4]). Hence, well-being was higher in the months of June and July for the 2019 sample, and so time of year cannot account for the present findings of low psychological well-being in the 2020 sample.

These overall differences between the samples were moderated by interactions with both gender, $F_{(1, 22,279)} = 10.58$, $p = 0.001$; $\eta_p^2 = 0.001$, and age, $F_{(1, 22,279)} = 21.60$, $p < 0.001$; $\eta_p^2 = 0.006$. The 3-way interaction term was not significant.

The interaction with gender is detailed in **Table 2**. The WEMWBS dropped by a greater amount from the 2019 sample to the 2020 sample for women than for men, although this effect size is small.

The interaction with age is also detailed in **Table 2**. The change in scores from the 2019 sample to the 2020 sample were systematically smaller as a function of increasing age group. Hence, the youngest age group has a difference of 9.1 points, while the oldest had a difference of 2.9 points.

Well-being as a function of deprivation index ($n = 9,726$) is displayed in **Figure 2** for the 2020 sample. ANOVA showed a small effect of gender, $F_{(1, 9,716)} = 32.57$, $p < 0.001$, $\eta_p^2 = 0.003$, and of deprivation index, $F_{(4, 9,716)} = 14.17$, $p < 0.001$, $\eta_p^2 =$

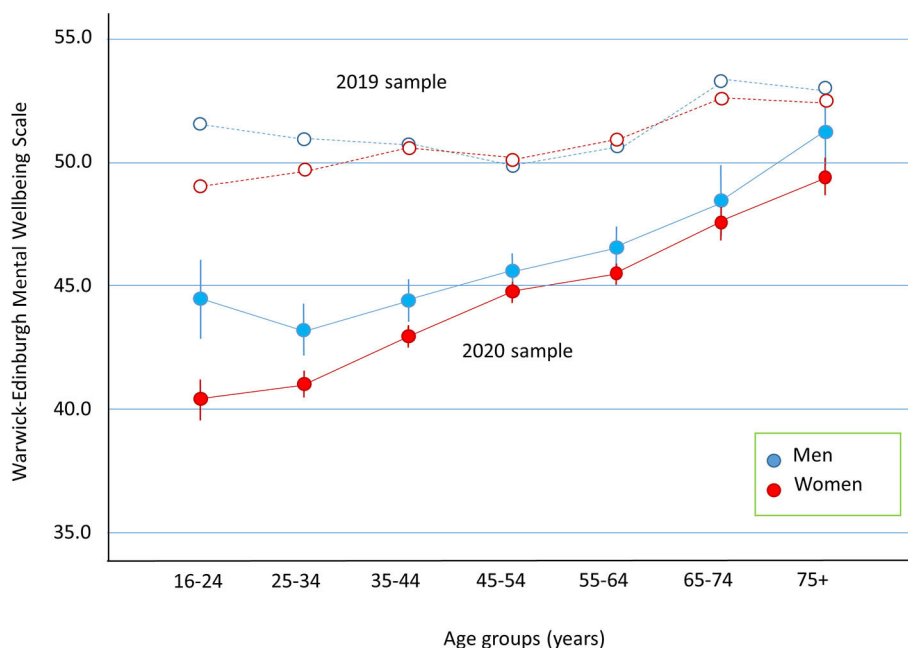
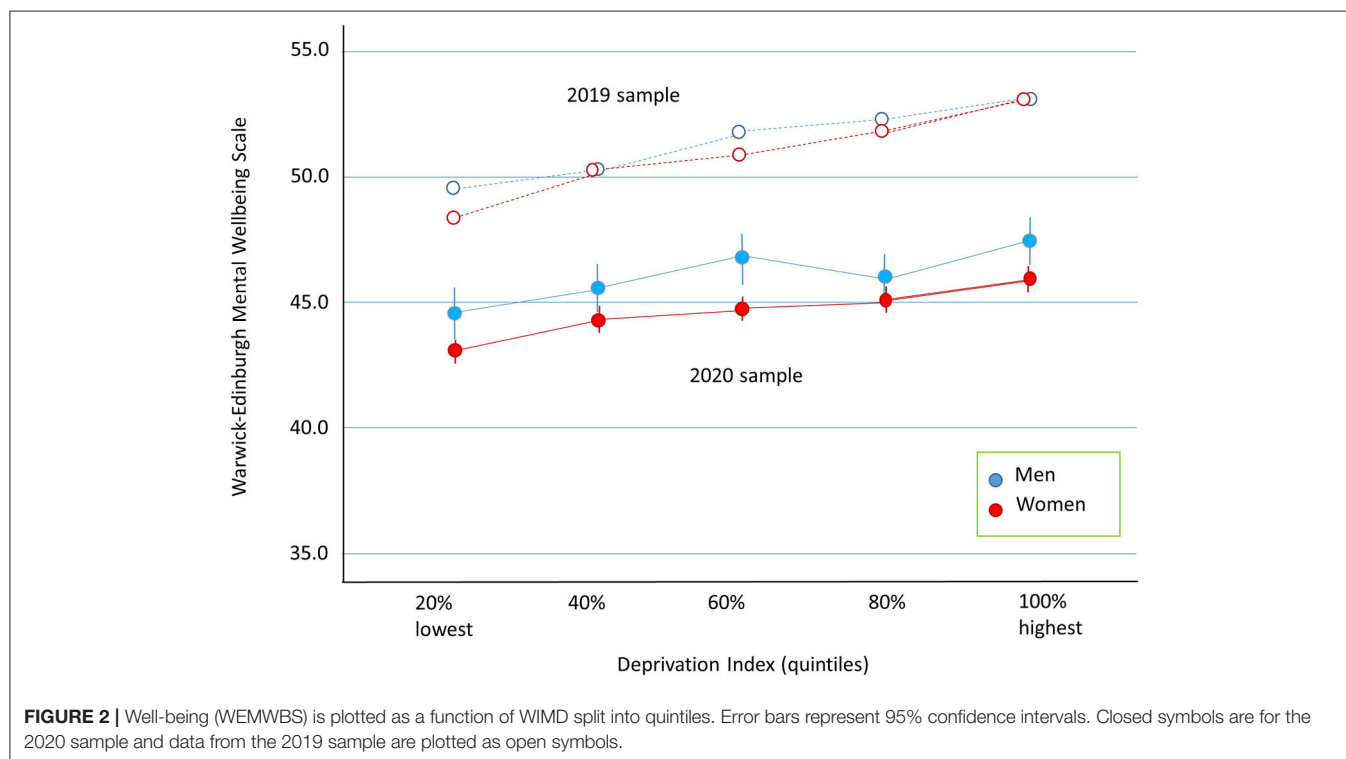


FIGURE 1 | Well-being (WEMWBS) is plotted as a function of age split into 10 year age groups. Error bars represent 95% confidence intervals. Closed symbols are for the 2020 sample and data from the 2019 sample are plotted as open symbols.

TABLE 2 | Results from the Warwick-Edinburgh Mental Wellbeing Scale. Numbers in square brackets represent 95% confidence intervals.

		Warwick Edinburgh Mental Well-Being Score		Difference [95% CI]	<i>p</i>	Effect size (Hedges G) [95% CI]	Low mental health/probable depression (WEMWBS ≤ 40)		Odds ratio
Sample		2020	2019				2020	2019	
Gender	Male	45.9	51.5	5.6 [5.1, 6.1]	<0.001	0.57 [0.52, 0.62]	30.0 [28.2, 31.8]	12.0 [11.1, 13.0]	3.14 [2.76, 3.56]
	Female	44.2	51.0	6.8 [6.4, 7.1]	<0.001	0.70 [0.66, 0.73]	35.5 [34.6, 36.4]	12.4 [11.6, 13.3]	3.94 [3.59, 4.31]
Age	16–24	41.2	50.3	9.1 [8.0, 10.2]	<0.001	0.95 [0.83, 1.06]	46.1 [42.3, 49.9]	14.0 [11.3, 17.0]	7.20 [5.45, 9.50]
	25–34	41.4	50.2	8.8 [8.1, 9.4]	<0.001	0.92 [0.84, 1.00]	47.5 [45.2, 49.8]	14.9 [12.9, 17.0]	6.31 [5.26, 7.57]
	35–44	43.2	50.7	7.5 [6.8, 8.1]	<0.001	0.79 [0.72, 0.86]	38.3 [36.5, 40.3]	13.7 [11.9, 15.7]	3.91 [3.28, 4.67]
	45–54	44.9	50.1	5.1 [4.6, 5.7]	<0.001	0.53 [0.47, 0.59]	32.4 [30.7, 34.0]	15.3 [13.5, 17.1]	2.66 [2.27, 3.10]
	55–64	45.7	50.8	5.1 [4.6, 5.7]	<0.001	0.51 [0.45, 0.57]	30.3 [28.6, 32.1]	13.7 [12.1, 15.3]	2.75 [2.35, 3.22]
	65–74	47.8	52.9	5.1 [4.4, 5.9]	<0.001	0.56 [0.47, 0.65]	23.3 [20.3, 26.4]	8.0 [6.9, 9.4]	3.48 [2.75, 4.41]
	75+	49.8	52.7	2.9 [2.1, 3.7]	<0.001	0.31 [0.22, 0.39]	16.4 [14.1, 19.0]	8.2 [6.8, 9.8]	2.21 [1.70, 2.88]



0.006, but the interaction was not significant. The results show that psychological well-being was reduced with increasing levels of deprivation.

Psychological Distress

The K10 was included in the study because of its well-established ability to categorize people in terms of clinically significant

levels of mental distress. Scores on the K10 were used to categorize people into “psychologically well (0–19),” “mild mental disorder/distress (20–24),” “moderate mental disorder/distress (25–29),” and “severe mental disorder/distress (30+).”

Using these criteria, 56.4% of the total sample ($n = 12,415$) showed clinically significant levels of mental distress (see **Table 3** for the full set of results). Further, in the present sample, 20.2% reached the criteria for “severe mental distress.”

Age was associated with psychological distress, $\chi^2(18, N = 12,407) = 762.37, p < 0.001$, see **Table 3**. Levels of distress were least in the oldest (75+) group, with 33.8% having clinical significance and 8.0% being classified as “severe,” and greatest in the youngest group (16–24) with 76.6 and 36.2%, respectively. Calculation of odds ratios using the oldest group as the comparison shows that individuals with severe psychological distress are 6.50 times more likely to be in the youngest age group in comparison to the oldest age group.

The extent of deprivation also influenced the proportions classified as mentally unwell on the K10, $\chi^2(12, N = 9,629) = 107.56, p < 0.001$. Details are shown in **Table 3**. To illustrate,

levels of “severe” psychological distress were greatest in the most deprived group (24.4%) and were nearly double that of the least deprived group (13.8%). Using the least deprived group as a comparison, individuals with severe psychological distress were 2.05 times more likely to be in the most deprived group compared to the least deprived group.

DISCUSSION

The data show lower levels of mental well-being during the COVID-19 pandemic (2020 sample) as compared to data collected in the year prior to the COVID-19 pandemic (2019 sample). In turn, the data show high levels of psychological distress during the COVID-19 pandemic, with around 50% of the population reporting clinically significant levels of psychological distress, and around 20% showing “severe” effects. This was particularly apparent in younger people, where around 1/3 of individuals are reporting “severe” levels of psychological distress. Psychological distress is also higher in women and those from

TABLE 3 | Results from the K10 measure of mental distress. Numbers in square brackets represent 95% confidence intervals.

K10		Score	Well (%)	Mild (%)	Moderate (%)	Severe (%)	Odds ratio (severe)
All		22.2 [22.1, 22.4]	43.6 [42.7, 44.4]	19.6 [18.9, 20.3]	16.7 [16.0, 17.4]	20.2 [19.5, 20.9]	–
Gender	Male	20.8 [20.5, 21.1]	52.6 [50.6, 54.6]	17.6 [16.1, 19.2]	12.8 [11.5, 14.2]	17.0 [15.6, 18.6]	1.00
	Female	22.6 [22.4, 22.8]	41.4 [40.4, 42.4]	20.1 [19.3, 20.9]	17.6 [16.9, 18.4]	20.9 [20.1, 21.7]	1.29 [1.14, 1.44]
Age	16–24	26.5 [25.9, 27.2]	23.4 [20.2, 26.6]	20.1 [17.1, 23.2]	20.3 [17.2, 23.3]	36.2 [32.6, 40.0]	6.50 [4.90, 8.63]
	25–34	25.4 [25.0, 25.8]	28.4 [26.4, 30.6]	19.4 [17.6, 21.3]	20.0 [18.2, 22.0]	32.2 [30.0, 34.4]	5.30 [4.15, 6.93]
	35–44	23.0 [22.7, 23.4]	38.3 [36.3, 40.1]	21.7 [20.1, 23.4]	19.2 [17.7, 20.8]	20.9 [19.3, 22.5]	2.97 [2.31, 3.84]
	45–54	21.8 [21.5, 22.0]	45.8 [44.0, 47.5]	20.3 [18.9, 21.7]	15.7 [14.5, 17.1]	18.2 [16.9, 19.6]	2.51 [1.95, 3.23]
	55–64	21.1 [20.8, 21.4]	49.9 [48.0, 51.9]	18.1 [16.7, 19.6]	15.6 [14.2, 17.0]	16.4 [15.0, 17.8]	2.21 [1.71, 2.86]
	65–74	19.5 [18.9, 20.0]	57.3 [53.7, 60.1]	19.3 [16.5, 22.3]	12.8 [10.5, 15.4]	10.6 [8.5, 13.1]	1.34 [0.96, 1.87]
	75+	18.2 [17.7, 18.6]	66.2 [63.1, 69.4]	15.7 [13.3, 18.0]	10.0 [8.1, 12.1]	8.0 [6.2, 9.8]	1.00
Deprivation Index	1 (most deprived)	23.2 [22.8, 23.6]	39.8 [37.6, 42.1]	19.6 [17.8, 21.4]	16.2 [14.6, 18.0]	24.4 [22.5, 26.3]	2.05 [1.74, 2.42]
	2	22.2 [21.9, 22.6]	42.8 [40.6, 45.1]	21.5 [19.7, 23.4]	16.1 [14.5, 17.8]	19.5 [17.8, 21.4]	1.54 [1.29, 1.82]
	3	21.9 [21.5, 22.2]	45.2 [43.0, 47.5]	18.9 [17.2, 20.7]	17.0 [15.4, 18.8]	18.9 [17.2, 20.8]	1.49 [1.26, 1.78]
	4	21.7 [21.3, 22.0]	47.2 [45.0, 49.5]	18.0 [16.3, 19.8]	16.9 [15.3, 18.7]	17.9 [16.2, 19.7]	1.39 [1.17, 1.65]
	5 (least deprived)	20.5 [20.2, 20.9]	52.2 [49.9, 54.4]	20.2 [18.4, 22.0]	14.4 [12.9, 16.1]	13.8 [12.2, 15.4]	1.00

deprived areas. These findings are broadly in line with previous studies (6, 8, 11, 12) but represent a more extreme effect.

Effects of Age

The finding of a greater effect of the pandemic on younger adults may be viewed as surprising given that COVID-19 causes far more serious illness and has greater lethality as a function of increasing age (45). There have also been reports of far greater anxiety due to COVID-19 in older adults in the UK (46). However, similar findings that the mental health of young adults has been most affected have been reported in previous studies published on this topic to date (6, 8, 11, 12).

Any stressor that affects the whole population will produce more people entering the “severe” category for those groups that already have lower well-being scores before the stressor, *via* a simple “additive” model. Levels of psychological distress using the K10 have been shown to reduce with age in other populations (47), while well-being is less affected by age (28, 48). However, the present data comparing scores on the WEMWBS in the year prior to the onset of the COVID-19 pandemic and during COVID-19 suggest an interaction whereby the stressors due to COVID-19 have a greater effect on younger people in the population (a non-additive model) producing an even greater number of young people who fall into the “severe” category compared to what would be predicted from a simple additive model.

The reasons for the greater effect of COVID-19 on the mental health of younger adults are not known. It is known that frequent social interaction outside of the immediate family, and forming and maintaining friendships, may be particularly important at this age and their loss more stressful or difficult to tolerate psychologically. For example, Roach (49) provides a review of the importance of peer relationships for mental health in adolescents and concludes that such relationships are protective against anxiety, depression, and suicidal ideation. Further, Beam and Kim (50) note that social isolation caused by the COVID-19 pandemic may affect young adults more than other age groups. Alternatively, older adults might have less stress due to such factors as financial security or employment stability (or retirement, etc.). Further research is needed to be able to isolate the “active” elements of the COVID-19 pandemic, and the corresponding community lockdown, upon deteriorating mental health so that public health interventions designed to ameliorate psychological distress on a population-wide level can be used to target the most potent factors.

Effects of Gender

Our data indicate greater levels of mental health problems due to COVID-19 in women and these results are consistent with previous findings (6, 8, 11, 12). Pre-COVID-19 studies have also indicated greater levels of psychological distress in women of a similar magnitude (51). While the reasons underpinning these gender differences are unclear, it is important to interpret these findings within the context of the robust gender differences in stress and coping (52, 53) and the gender differences in personality traits that may underpin

these effects (54). The resulting picture is that the number of women requiring mental health support and intervention due to COVID-19 is likely to be greater than that for men and the possibility that there may be a need for the development of different intervention strategies depending on gender.

Effects of Deprivation

The finding that economic deprivation has a negative effect on well-being and mental health is well-documented [e.g., WEMWBS see (55); K10 see (51)]. While the data are clear in showing higher levels of psychological distress as a function of deprivation index, it is not clear from our data if this is merely due to a lower overall level of mental health pre-COVID-19 (an additive effect) or whether the COVID-19 pandemic has had a greater overall impact on people from more deprived areas. Either way, the implication of these results is that mental health and support services that cover areas of higher deprivation are likely to see a greater demand for psychological and mental health intervention and that communities and governments will need to plan for this increase in population need.

Finally, it should be noted that our index of deprivation was indirect as it was based on the participant's postcode. Future research may wish to gather more direct data about the individual circumstances of the person.

Limitations and Future Research

The current data has several limitations. First, the 2020 sample was recruited from adults living across Wales and appears to reflect the demographics of this population. However, our recruitment strategy meant that certain sectors of the population who might be more at risk of experiencing psychological distress or negative impacts on mental well-being were not sampled in sufficient detail for us to be able to give separate estimates of well-being and psychological distress for these groups. For example, Black Asian and Minority Ethnic groups (BAME) in the UK appear to have suffered greater mortality rates due to COVID-19 than the white ethnic population (56), and this could well be reflected in a greater deterioration, or a greater impact of COVID-19, on mental health and well-being in BAME communities.

Second, the present study did not sample from people aged 15 or lower. Given that the data show the greatest impact on psychological distress in the youngest age group sampled, data are needed on these young people and on children and adolescents living through the COVID-19 pandemic so that appropriate intervention strategies can be applied, if necessary.

Third, the survey technique (online collection with snowballing advertisement) for the 2020 sample differs from the 2019 sample where face-to-face interviews were conducted on selected households to represent the population of Wales. Importantly, the demographic data from the 2020 sample appears to be in close accord with that of the 2019 sample. The exception to this is that our sample contained fewer people in the older age groups. The reason for this is not known, but it seems probable

that this reflects less usage of social media and access to the internet. However, this leaves open the possibility that only the more psychologically healthy older adults completed the survey. If so, then our figures may represent an underestimation of mental health issues in the population and in this age group.

Fourth, the 2020 and 2019 samples may differ on other, non-measured, factors. The most obvious of these factors is the willingness of an individual to complete such a survey, which may be biased toward those people who have been most affected by the COVID-19 pandemic or who have more interest in mental health issues. However, this limitation is inherent to all survey techniques (8), although whether the effect is greater in the present sample is not known.

Finally, this research aimed to examine how the COVID-19 pandemic affected the mental health and well-being of the Welsh population across key demographic variables (age, gender, socioeconomic status). This research cannot provide more specific information on how potentially psychologically vulnerable subgroups have been affected by the COVID-19 pandemic. Certain subgroups such as individuals with specific mental health diagnoses (57), individuals who experienced childhood maltreatment (58), or individuals with abnormal sensory processing patterns (59) are more vulnerable to negative psychiatric and mental health outcomes and future research should investigate how these groups have been affected by the COVID-19 pandemic.

Conclusion

The data point to a decrease in psychological well-being in the people of Wales in the period 11–16 weeks since the implementation of lockdown measures due to the COVID-19 pandemic. In turn, this translates to an increase in clinically significant levels of psychological distress in Wales, with a 3- to 4-fold increase in those classed as having “severe” problems. The problems appear to be particularly severe in younger adults and also greater for women, and for those from areas of greater deprivation. These important findings can be used to prepare and plan for the wave of psychological distress that has been predicted to hit mental health and support services due to the COVID-19 pandemic and which now appear to be materializing. Given the consistency of our findings with data from the USA (6) and the UK (8, 11), we suspect that similar patterns of deteriorating mental health will emerge in other countries. We are learning that the impact of the pandemic itself, and the emergency governmental response to it, have not only had profound economic consequences, but have also had a significant impact on the mental health of the Nation.

Added Value of This Study

This is the first study to examine mental health of a nation for a period well into the COVID-19 crisis and lock-down (11–16 weeks) and to compare this to data for a comparable sample before the advent of COVID-19 (2019). We also took measures of both psychological well-being and of clinically significant levels of mental distress using well-established instruments.

We found levels of poor psychological well-being and mental distress that were well above pre-COVID-19 levels and far greater than the previous studies of the early period of the crisis. We found these problems were not evenly distributed across the population, but had a more dramatic effect on younger adults. Greater levels of mental distress were also found in women and those from the most deprived areas, although these effects were more modest.

Implications of All the Available Evidence

The data point to a dramatic decrease in the mental health of the nation of Wales, with over 20% of people reporting “severe” levels of distress. While the physical effects of COVID-19 might be most apparent in older adults, the effects on mental health are more severe in younger people. The data point to the need for government and local health services to prepare for a wave of mental health problems which may follow in the footprints of the pandemic. While the active ingredients causing the mental health deterioration have not yet been isolated, there is a need to balance the efforts to stop the spread of the virus against the mental health problems being caused by the crisis. Our data, compared to that of studies published earlier in the COVID-19 pandemic, point to a deepening problem that is likely to continue with possible “second waves” of infection and the effects of economic problems precipitated by the pandemic and governmental response to it. Continued monitoring of the situation is required, alongside studies that examine which aspects of the pandemic are responsible for this deterioration of the mental health of a nation.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Research Ethics Committee at the College of Health Sciences, Swansea University. Written informed consent from the participants’ legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

CO’C and NG devised the study concept. JK and NG wrote the research proposal and sought and obtained ethical approval and research governance permissions for the research from each of the seven Health Boards in Wales. CO’C coordinated the Health Boards’ response to the research. JP and NS created the online survey in Qualtrics, monitored and downloaded data, and wrote scripts for data translation and analysis. NS wrote the Welsh translations. SW designed and implemented the website and led on social media engagement. NG, JK, NS, and RS wrote the study registration on ISRCTN and Research Protocol, now published online by Swansea University. RS wrote the initial analysis plan

with input from all authors, carried out data analysis, produced figures, and wrote the first draft of the manuscript. JK checked all the analyses. All authors collaboratively devised the survey questions and aims, contributed to the dissemination of the survey, and contributed to editing and commenting on the final version.

ACKNOWLEDGMENTS

We are grateful to Joy Garfitt, Richard Jones, Philip Lewis, David Roberts, Alberto Salmoiraghi, and Ian Wile, who (along with CO'C) acted as the Principle Investigators in each of the seven Health Boards in Wales, for their help and support in disseminating this survey both to staff within their Health Boards and to the local populations they serve. We are also grateful to Jo Jordan, National Programme Director for Mental Health (NHS Wales), for her assistance and support with this research.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The Impact of Coping Strategies and Perceived Family Support on Depressive and Anxious Symptomatology During the Coronavirus Pandemic (COVID-19) Lockdown

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OPEN ACCESS

Edited by:

Paola Aceto,
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Reviewed by:

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Technology, Australia
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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 27 July 2020

Accepted: 12 October 2020

Published: 13 November 2020

Citation:

Mariani R, Renzi A, Di Trani M,
Trabucchi G, Danskin K and
Tambelli R (2020) The Impact of
Coping Strategies and Perceived
Family Support on Depressive and
Anxious Symptomatology During the
Coronavirus Pandemic (COVID-19)
Lockdown.
Front. Psychiatry 11:587724.
doi: 10.3389/fpsy.2020.587724

The coronavirus pandemic represents a severe global crisis, affecting physical, and psychological health. Lockdown rules imposed to counteract the rapid growth of COVID-19, mainly social restrictions, have represented a risk factor for developing depressive and anxious symptoms. The research aims are to explore the effect of coping strategies and perceived social support on depressive and anxious symptomatology during the COVID-19 pandemic. Ninety-six healthy people (46 males, mean age = 39.3; SD = 16.6) completed through on-line platform: Socio-demographic questionnaire, Coping Inventory for Stressful Situations (CISS), Multidimensional Scale of Perceived Social Support (MSPSS) and Symptom Checklist-90-Revised (SCL-90-R), 3 weeks after the imposition of lockdown restrictions. SCL-90-R Depression scores showed significant positive correlation with CISS Emotion ($r = 0.85$; $p = 0.001$) and Avoidant ($r = 0.34$; $p = 0.018$), a significant negative correlation with MSPSS Family support ($r = -0.43$; $p = 0.003$). SCL-90-R Anxiety scores showed a significant positive correlation with CISS Emotion ($r = 0.72$; $p = 0.001$) and Avoidant ($r = 0.35$; $p = 0.016$). No significant correlations between both CISS Emotion and Avoidant scales with social support emerged. Two Multiple Linear Regression analysis were performed using, respectively, SCL-90-R Depression and Anxiety scores as dependent variables, and the CISS and MSPSS scales, age, and gender as predictors. The first regression model ($R^2 = 0.78$; adjusted $R^2 = 0.75$) revealed CISS Emotion ($\beta = 0.83$; $p = 0.001$) and MSPSS Family support ($\beta = -0.24$; $p = 0.004$) had a predictive effect on SCL-90-R Depression scores. The second regression model ($R^2 = 0.52$; adjusted $R^2 = 0.472$) revealed that only CISS Emotion ($\beta = 0.71$; $p = 0.001$) predicted the SCL-90-R Anxiety scores. In conclusion, during the COVID-19 pandemic lockdowns, coping focus on emotions seemed to increase anxious and depressive symptoms, probably due to the uncontrollable nature of the stressful event and the high emotional response. Family support which reduces the sense of loneliness had an exclusive role in mitigating

depressive symptoms. These results highlight the importance of promoting psychological strategies to improve emotional regulation skills, reducing isolation from family, to prevent mood symptomatology in healthy citizens during large-scale health crises.

Keywords: COVID-19, coronavirus pandemic, depression, anxiety, coping strategies, perceived support

INTRODUCTION

As nations around the globe continue their battle with the COVID-19 pandemic, it has become clear that people in some regions will experience repeated lockdown or quarantine periods. If this unfortunate reality is to be faced and endured, it is important that mental health providers are armed with accurate information about how to help the public survive these periods of isolation and inactivity with minimal psychological impact. When lockdown procedures began, protection of physical health was the top priority, but those familiar with the impact of phenomena like isolation, loneliness, and unemployment on mental health braced for an additional threat.

Now that initial lockdown limitations all around the world are either beginning to lift, or becoming the “new normal” in places where they have continued for many months, some research is emerging that will assist in the development of environmental and psychological interventions to lessen their impact moving forward. The authors of this paper hope with the present research to make a contribution to that work, specifically in the areas of coping strategies and social support. Clinicians who treat individuals with symptoms of depression and anxiety know that a healthy social and physical environment is critical for maintenance of balanced mental health. Indeed, the first clinical recommendations for many of the patients presenting with such symptoms, particularly those with depression, are often to increase social interaction and support, engage in a wider variety of activities outside the home, and engage in activities that foster a sense of mastery, including work. With these options severely limited due to lockdowns, it was clear that many people would find it difficult to navigate their mood, anxiety, and other mental health challenges. Studies carried out in previous instances of highly infectious diseases and pandemics have shown that social isolation produces serious psychological and emotional repercussions (1, 2). Taylor et al. (3) found that 34% of quarantined horse owners reported psychological distress during the equine influenza epidemic compared to 12% in the general population. In another study, parents who experienced a variety of disease containment lockdowns were found to endorse 6% more trauma-related psychological symptoms than parents who had not experienced lockdowns (4).

Research that has been conducted thus far in countries impacted by COVID-19 supports the hypothesis that the pandemic and related lockdowns have had a significant impact on mental and physical health (5). Some of this research has focused on stress and trauma symptomatology. Relatively significant correlations have been found between COVID-19- PCL-5 [a version of the Posttraumatic Stress Disorder Checklist for DSM-5

developed by (6), modified by (7)] scores, general distress and sleep disturbances. A high percentage of PTSD symptoms (29.5%) was found in the Italian population (7). Survey findings from Liu et al. (8), indicated that the prevalence of post-traumatic stress symptoms in hard-hit areas of China ~1 month after the emergence of the virus was 7%, and had particularly impacted women. In a Spanish study (9) it was reported that 41% of their survey respondents reported feeling stressed. Wang et al. (10) reported that 8.1% of their Chinese respondents were experiencing moderate to severe stress. The COVID-19 pandemic is likely to be considered a traumatic event, especially by those whose life circumstances have been affected. The pandemic has also presented particular challenges for individuals who struggle with substance use due to the fact that social isolation and despair are risk factors for the development and exacerbation of addiction (11, 12). Professionals across multiple disciplines have raised alarms about the potential for increased family violence or intimate partner violence [e.g. (13–15)] as a result of increased exposure to exploitative relationships and economic stress, as well as reduced support.

The social and economic features of the pandemic have created conditions that are strongly associated with mental health issues. Information about the pandemic has changed regularly, as epidemiologists and other professionals have tracked its progress and examined its characteristics, which has meant that the everyday citizen may feel that they are lacking in knowledge or distrustful of the latest findings. Individuals in affected areas have worried about how they will meet basic needs like food and medicine, and have struggled with fear of contagion. Lockdown rules have reduced contact with social and professional connections while producing concerns about financial stability.

Brookings Institution (16) reported thirty-eight million people in 20 wealthy democracies around the world had filed for unemployment insurance over the course of the pandemic. Prior research on the psychological impact of unemployment has been quite clear; a meta-analysis (17) of 324 cross-sectional and longitudinal studies found that on average, 34% of unemployed people experienced psychological problems, compared with 16% among those who were employed. Burnout is one additional social factor that may become increasingly relevant to the development of pandemic-related psychopathology as pressures on families—especially parents—continue to mount; it may resonate deeply with those engaged in intense, concurrent domestic and professional labor during this crisis, and may produce some of the same psychopathology (18–20). Burnout in individuals in the health profession in particular should be taken into consideration as a social implication of the pandemic (21).

Anxiety and depression symptoms related to COVID-19 pandemic have been a topic of intense interest among researchers. Their proliferation among the populations of many of the affected nations appears to be widespread according to early studies. Wang et al. (10) reported that 16.5% of their respondents in China reported moderate to severe depressive symptoms and 28.8% reported moderate to severe anxiety symptoms. Cao et al.'s (22) survey of Chinese undergraduate college students found that 0.9% of the respondents were experiencing severe anxiety, 2.7% moderate anxiety, and 21.3% mild anxiety. Similarly, Huang and Zhao (23) found significant psychopathology among their participants in China—35.1% endorsed symptoms of generalized anxiety and 20.1% endorsed depressive symptoms. Similar findings have been reported in Nepal [(24); a preprint study indicating depression, anxiety and depression-anxiety co-morbidity reported by 34, 31, and 23.2%, respectively], the Philippines [(25); COVID stress significantly predicted depression and anxiety], and India [(26); depression, anxiety and insomnia symptoms reported by 12.7, 9, and 21%, respectively]. In Europe, Rodriguez-Rey et al.'s (9) study found that 25% of their Spanish respondents showed mild to severe levels of anxiety and 41% reported depressive symptoms. In Bäuerle et al.'s (27) study, on 15,704 German participants, the overall prevalence of elevated anxiety and depressive symptoms was 44.9 and 14.3%, respectively. Solomou and Constantinidou's (28) study in Cyprus was roughly equivalent in its findings—41% of respondents reported symptoms of mild anxiety; 23.1% reported moderate-severe anxiety symptoms; and 48% reported mild and 9.2% moderate-severe depressive symptoms. As specifically regards Italy, Gualano et al. (29) found that during the last 14 days of lockdown on 1,515 participants enrolled in their national survey the prevalence of depression and anxiety symptoms was 24.7 and 23.2%, respectively. In their study, increasing age, an absence of work-related troubles and being married or being a cohabitant reduced the likelihood of at least one mental health outcome. Furthermore, in a recent meta-analysis the prevalence of anxiety symptomatology, investigated in 17 studies was obtained as 31.9%, whereas the prevalence of depressive symptoms, investigated in 14 studies, was reported as 33.7% (30). While the above studies focused mainly on the general population, the currently available research suggests that frontline healthcare workers in particular have experienced increased depression and anxiety symptoms [see (31) for an overview of ten studies conducted in Asia on this topic]. Similarly, Cao et al. (22) found that during the COVID-19 lockdown their sample of college students experienced economic effects, and effects on daily life, as well as delays in academic activities, that were positively correlated with anxiety symptoms. Anxiety and depression symptoms may be appropriate reactions to these extreme circumstances, but over time or with increased intensity, they may become maladaptive and impair functioning (32).

Recent research has explored the effect of social support and coping strategies in relation to anxiety and depression. During the pandemic, greater levels of perceived social support appears to have been serving as a protective factor for affected individuals (22). One recent study shows that different levels

of social support for medical staff were significantly correlated with self-efficacy and sleep quality and negatively correlated with the degree of anxiety and stress (33). However, social support is a multidimensional factor and loneliness can not necessarily be identified and assessed based on the number or absence of social contacts. Both depend on an individual's self-perception of "how I feel supported or alone." Bruwer et al. (34) asserted that social support is a complex and multidimensional construct whose explanation is still the subject of numerous interpretations. Thoits (35) suggested that social support operates primarily as "coping assistance" with the negative effects of stress, which increases self-esteem and a sense of control over the environment. Social support is in contrast with loneliness, which may lurk in the hearts of people who are ostensibly surrounded by and engaged with others. Often it is preceded by significant changes in the person's life. It has a strong negative impact on mental and physical health, including premature death at rates comparable to obesity and smoking (36).

During the COVID-19 pandemic, it is very important to evaluate the difference between the effect caused by the physical distancing imposed by lockdowns and the extent to which individuals subjectively feel lonely or feel supported by others. Social isolation is evident to an observer as a state in which a person is neither in close proximity with nor are they interacting with others. They may not actually feel alone. It is also important to remember that social support is complex and can vary based on the type of support provided by significantly different figures, such as family, friends or others (37). Research has also highlighted that different kinds of support can have different impacts on stress reduction (38); in fact, support specifically from family and friends during the COVID-19 pandemic appears to have been helping people feel sustained and share their feelings (39). In addition to social support, various coping strategies appear to have differing effects in preventing or fostering psychological symptoms. Extant literature regarding the combined psychological responses and coping methods used by the general population in past outbreaks has shown that coping strategies have included problem-focused coping (seeking alternatives, self- and other-preservation) and seeking social support to mitigate anxiety and depression (40). Given the nature of the COVID-19 pandemic, coping strategies have been affected by announcements of clear rules for citizens to follow; social media communications and expert advice encouraged a task-oriented coping strategy. These factors have helped people to try to behave calmly and appropriately (41). This complements previous research which has demonstrated that high levels of emotion-oriented coping and low levels of task-oriented coping tend to correlate positively with burnout in healthcare workers (42, 43). As specifically regards the coping behaviors associated with decreased anxiety and depressive symptoms during the COVID-19 pandemic and lockdown in a Spanish study (44) it has been found that following a healthy/balanced diet and not reading news/updates about COVID-19 very often were the best predictors of lower levels of anxiety symptoms, whereas following a healthy/balanced diet, and a daily routine, not reading news/updates about COVID-19 very often, taking the opportunity to pursue hobbies, and staying outdoors or looking

outside were the best predictors of lower levels of depressive symptoms. Furthermore, in a Swiss study (45) the coping strategies associated with reduced emotional distress in young adults included keeping a daily routine, physical activity, and positive reappraisal/reframing.

Given the proliferation of depression and anxiety symptoms as primary psychological consequences of the pandemic and lockdown procedures, it is increasingly clear that interventions must be developed quickly to soften the impact of additional lockdowns and the ongoing threat of the virus, as well as potential future pandemics. With that in mind, the present authors have explored how various coping strategies have increased or decreased these symptoms, and worked to discover the role of social support in this process. The research aims are to explore specific how coping strategies and perceived social support have been impacting depressive and anxious symptomatology during an extended period of lockdown rules during the COVID-19 pandemic in a healthy sample. In particular it is hypothesized that:

- The adoption of task-focused coping strategies is related to less anxiety and depressive symptoms;
- Emotional coping is related to increment of anxiety and depression symptoms;
- Family support in particular is related to fewer symptoms of anxiety and depression during the COVID-19 pandemic.

MATERIALS AND METHODS

Participants

The study focused on healthy Italian individuals enrolled based on the following inclusion criteria:

- having been subject to lockdown social restrictions rules;
- between the ages of 18 and 70
- having adequate understanding of the Italian language and living in Italy at the time of the lockdown;
- possessing the technical ability to access to the on-line platform to complete questionnaires.

We excluded people who had previously received a psychiatric diagnosis; those who take medication for psychiatric reasons; and individuals who were working as healthcare professionals during the pandemic. A total of 98 healthy subjects (46 males) participated in the study. The participants had a mean age of 39.3 ($SD = 16.6$). Additionally, 45.8% reported an educational level of 13 years, 41.7% of 16 years, and 12.5% over 16 years. Similarly, 45.8% indicated that they were married/cohabiting; 25.2% were unmarried/not cohabiting and living independently (may have had roommates); 8.3% were divorced; and 20.7% were single living with their families of origin.

Procedure

The survey protocol received the ethical approval by the Sapienza University Ethics Committee. The study was conducted in the first week of April, 2020, 3 weeks after the imposition of lockdown restrictions. The choice of performing the evaluation 3 weeks after the imposition of lockdown restrictions depended on the

need to let some time to pass from the imposition of restrictions in order to be able to evaluate their effects after a first period of new of the event. This since the aim was not to investigate population's immediate reaction to lockdown restrictions but the impact of this prolonged difficult situation on people's psychological health. The participants were invited to complete and on-line survey asking them to share their insights into how people feel about the global health emergency and how they are coping with it. The participants were enrolled using snowball sampling. The surveys were made available through an on-line platform where participants gave their informed consent before completing the self-administered questionnaire.

Measures

Socio-Demographic Questionnaire

A socio-demographic questionnaire was designed to collect information concerning age, gender, education level, social status and occupation.

The Symptom Checklist-90-Revised

The Symptom Checklist-90-Revised [SCL-90-R; (46)] is a 90-item self-report inventory which measures psychological and psychosomatic symptoms occurring in psychiatric, medical, and general population participants. Each item is a description of a psycho-physical symptom and is rated by respondents on a five-point Likert scale (0–4) from having caused no discomfort to extreme discomfort during the past week. The SCL-90-R has 9 subscales: (1) Somatization, (2) Obsessive-Compulsive, (3) Interpersonal Sensitivity, (4) Depression, (5) Anxiety, (6) Hostility, (7) Phobic Anxiety, (8) Paranoid Ideation and (9) Psychoticism. The sum of all 9 subscales is the Global Severity Index (GSI), which can be used as a summary of the test, reflecting overall psycho-physical distress. In the present study the focus was placed on the Depression and Anxiety scale scores (47). The SCL-90-R showed adequate test-retest reliability, internal consistency and concurrent and discriminant validity. Cronbach's alpha of subscales in the present study ranged from 0.76 to 0.87.

Coping Inventory for Stressful Situations

The Coping Inventory for Stressful Situations [CISS; (48, 49)] is a questionnaire of 48 items measured on a Likert scale from 1 (not at all) to 5 (very much). Respondents are asked to indicate how much they engage in these types of activities when they encounter a difficult, stressful, or upsetting situation. The questionnaire measures along three coping dimensions: (1) Task-oriented coping, in which the main emphasis is placed on tasks or planning, and on attempts to solve problems; (2) Emotion-oriented coping, in which individuals engage in emotional reactions that are self-oriented. It includes emotional responses such as getting angry, becoming tense, as well as self-preoccupation and fantasizing, as in daydreaming reactions. (3) Avoidance-oriented coping describes activities and cognitive changes aimed at avoiding the stressful situation. The test showed good psychometric properties including internal-consistency, test-retest reliability, and concurrent and discriminant validity (50).

TABLE 1 | Participants' questionnaire means scale scores.

Variables	M	Sd
SCL-90-R		
Depression	0.86	0.66
Anxiety	0.78	0.53
Global Severity Index	0.62	0.46
CISS		
Emotion	35.68	12.49
Avoidant	45.38	8.12
Task	56.34	9.43
MSPSS		
Family	5.25	1.03
Friends	5.45	1.22
Significant others	4.06	0.88
Total	5.48	0.85

SCL-90-R, Symptom Checklist-90-Revised; CISS, Coping Inventory for Stressful Situations; MSPSS, Multidimensional Scale of Perceived Social Support.

Multidimensional Scale of Perceived Social Support

The Multidimensional Scale of Perceived Social Support [MSPSS; (51)] is a self-report measure of subjectively perceived social support. The questionnaire is composed of 12 items rated by respondents on a Likert scale ranging from 1 (totally false for me) to 7 (totally true for me). The questionnaire measures three different sources of support: Family (4 items), Friends (4 items), and Significant Other (4 items), and there is also a total support score (12 items). The questionnaire demonstrated good internal and test-retest reliability (52).

Data Analysis

All statistical analyses were performed using the Statistical Package for Social Science version 25 (SPSS version 25) for Windows (IBM, Armonk, NY, USA). Data were reported as frequencies and percentages for discrete variables, and as means and standard deviations for continuous variables. Pearson's correlation analysis was used to measure the association between depression/anxiety levels, coping strategies, perceived social support, age and gender. Two Multiple Linear Regression models were performed using, respectively, Depression and Anxiety scores as dependent variables, and age, gender, CISS and MSPSS dimensions that were significant from the correlation analysis as predictors. A $p < 0.05$ was considered significant.

RESULTS

In the sample that was evaluated, 33.3% of the participants showed elevated symptoms of depression and 35.4% elevated symptoms of anxiety (in both cases, scores equal to or >1 in the Depression and Anxiety SCL-90-R scores).

The questionnaire mean scale scores of the participants are presented in **Table 1**.

In regards to the correlational analysis (see **Table 2**), SCL-90-R Depression scores showed a significant positive correlation with CISS Emotion ($r = 0.84$; $p = 0.001$) and CISS Avoidant ($r = 0.34$;

TABLE 2 | Correlation between depression and anxiety, with coping, and social support dimensions.

	SCL-90 R Depression	SCL-90 R Anxiety	CISS Emotion	CISS Avoidant	CISS Task
Age	-0.232	-0.170	-	-	-
Gender	0.194	0.194	-	-	-
CISS Emotion	0.849**	0.719**	-	-	-
CISS Avoidant	0.343*	0.349*	-	-	-
CISS Task	-0.272	-0.173	-	-	-
MSPSS Family	-0.426**	-0.277	-0.238	-0.007	0.188
MSPSS Friends	0.130	0.190	0.208	0.259	0.040
MSPSS Significant others	-0.208	-0.118	-0.266	-0.106	0.120
MSPSS Total	-0.182	-0.064	0.021	0.178	0.126

** $p < 0.01$; * $p < 0.05$.

SCL-90-R, Symptom Checklist-90-Revised; CISS, Coping Inventory for Stressful Situations; MSPSS, Multidimensional Scale of Perceived Social Support.

$p = 0.018$) coping styles, and a significant negative association with MSPSS Family support ($r = -0.426$; $p = 0.003$). SCL-90-R Anxiety scores showed a significant positive correlation with CISS Emotion ($r = 0.719$; $p = 0.001$) and CISS Avoidant ($r = 0.35$; $p = 0.016$) coping styles. No significant associations between either CISS Emotion or Avoidant scales with social support emerged.

A first multiple linear regression model was performed using the SCL-90-R Depression score as dependent variable and age, gender, CISS Emotion and Avoidant and MSPSS Family support (significant in the correlational analysis) as independent variables. The model explains the 78% of the Depression scores ($R^2 = 0.78$; adjusted $R^2 = 0.75$), thus indicating an adequate fit of the model tested. The independent variables that showed a significant effect were: CISS Emotion ($\beta = 0.83$; $p = 0.001$) and MSPSS Family support ($\beta = -0.24$; $p = 0.004$).

A second multiple linear regression model was performed using the SCL-90-R Anxiety score as the dependent variable and age, gender, CISS Emotion and Avoidant (significant in the correlational analysis) as independent variables. The model explains the 51% of the Anxiety scores ($R^2 = 0.52$; adjusted $R^2 = 0.47$), thus indicating an adequate fit of the model tested. The only independent variable that showed a significant effect was CISS Emotion ($\beta = 0.71$; $p = 0.001$).

DISCUSSION

During the COVID-19 pandemic, social distancing has been implemented in many countries, including Italy, to interrupt viral transmission and delay the spread of infection. These measures have come at a cost of socially isolating many people, putting their mental health at risk, since social isolation can lead to loneliness, a subjective psychological state identified through introspection that has been found consistently to be associated with depression, suicidal ideation and anxiety (53–59).

Coping styles and the perceived social support both appear to contribute to individuals' management of the stress of social isolation and the sense of loneliness that can derive from it.

The present work therefore aims to evaluate the relationships among specific coping strategies, perceived social support and anxious/depressive symptoms in the Italian general population exposed to COVID-19 during the lockdown period.

Consistent with previous studies [e.g., (9, 10, 22–24)], the presence of depression and anxiety symptoms was found in the sample we examined; specifically, 33.3% of the participants showed elevated symptoms of depression and 35.4% had elevated symptoms of anxiety (in both cases, scores equal to or <1 , in the Depression and Anxiety SCL-90-R scores). These percentages appear, from a qualitative point of view, comparable or, in some cases, higher than those found in the other studies [depressive symptoms: 16.5% in (10); 20% in (23); 12% in (26); 9.2% in (28); anxious symptoms: 25% in (22); 9% in (26); 25% in (9)]. It seems important to consider that Italy was one of the first countries to be significantly affected by COVID-19 and that it immediately instituted complete social isolation measures. The speed with which the phenomenon had spread in some regions of the country, the lack of knowledge relating to the management of the virus and the uncontrollability of the pandemic all contributed to the stressful experience that may have led to an intense and not-regulable emotional reaction, expressed in anxiety and depressive symptoms.

Regarding the relationships among coping styles, perceived social support and depressive/anxious symptoms, correlational analysis showed that depressive symptoms were positively correlated with emotional coping style, avoidant coping style and low social support, specifically related to family support. The hypothesis that using a task-oriented coping style would be protective was not supported, but a relationship between the use of the emotional reaction as a strategy to cope with the stressful event and the presence of depressive symptoms was found, as hypothesized. It is possible that, in the face of such an uncontrollable, generalized, new and indefinite event as the COVID-19 pandemic, the emotional reaction can be very intense. Attempting to use it as a strategy to manage the condition, external and internal, can therefore be not only inappropriate but also frustrating, and increase stress levels. The lockdown rules, also, restricted people to their homes, a situation which may have threatened their sense of efficacy as their freedom to solve problems and create strategies was limited. Other research has demonstrated that this phenomenon may have been different for nurses, who engaged in more task-oriented coping strategies (60). In a condition of high dysregulation, even the attempt to focus on the concrete problem management can fail, especially when the problem is unknown and not controllable. In these cases, it may be more effective to avoid focusing on emotions, since doing so can lead to depressive symptoms, perhaps because the uncertainty inherent in the situation makes it impossible to fully process them.

Moreover, the lack of a source of regulation, such as the presence of significant relationships, can exacerbate emotional dysregulation, increasing loneliness and depressive symptoms. The specific aspect of social support linked to depression in

this study was perceived family support. This aspect appears important because in Italy people have been forced to stay at home for more than 2 months, and therefore they have lived, in most cases, only with family members. Even in the Phase II of pandemic management following full lockdowns (Phase II started in Italy 3rd June after Phase I, which was characterized by total lockdown. Phase II was a Government strategy to maintain social distance but re-open all work activities), people were granted the freedom to visit only relatives, but not friends. Family relationships have taken on an important role, acting as a buffer against stress if they were adequate and supportive, or as a risk factor for depression, if perceived as deficient and inadequate. Loneliness refers to subjective dissatisfaction with the discrepancy between the perception of one's desired social network and that which is apparent to the individual (61, 62). It is not necessarily about being alone, but is connected to the perception of being alone and isolated that matters most. In other words, it is a state of mind which affects one's ability to find meaning in their life and creates unpleasant feelings of deficiency in social relations. It is important to highlight the distinction between social isolation and loneliness. What we observed in this study was not a depressive phenomenon linked to social isolation, but rather a sense of loneliness related to the perception that family relationships—the only sources of support at the time of the lockdown—were unable to perform this function. Regression analysis confirmed the specific role of the emotion oriented coping style and family support as predictors of depressive symptoms, supporting the possibility that an avoidant strategy was secondary to the failure of the emotion-oriented coping style.

Regarding anxious symptoms, correlation analysis showed a relationship between anxiety and emotion oriented and avoidant coping styles, whereas the regression analysis confirmed only the role of the emotional strategy in predicting anxious symptoms. Analysis did not demonstrate a relationship between perceived social support and anxiety. Depression and anxiety can be considered to be different symptomatic expressions of the same state of emotional dysregulation, which in one case results in a chaotic expression of the emotion and, in the other, in an emotional flattening. Even in the case of anxiety, too intense emotions cannot be used effectively to manage stress, as they need to be identified and regulated first. Social support seems to be specifically related to depression, probably mediated by the sense of loneliness.

The results of this study can be useful to orient not only psychological interventions for the general population in the post-emergency period, but also to direct health policies that take into account the psychological health of citizens. In the first area, implementing health promotion interventions aimed to strengthen emotion management strategies in stressful conditions could be useful; as regards health policies, it could be useful to consider the possibility of supporting significant social relationships (not just family ones) as much as possible through policies of improvement of virtual spaces where people can gather. The greater use of the internet and social media that the pandemic has engendered could be the basis for the construction of online support interventions for individuals and for small

groups. Many psychological services and research projects are moving toward promoting teletherapy and other treatments that can be provided remotely, mostly in order to address the needs of the general public, but also to support medical professionals who have suffered enormous stress providing treatment during the pandemic (63).

There are several limitations to the present study. First is the limited size of the sample, which cannot be representative of the full Italian population, and so certainly cannot necessarily represent all populations globally. It should also be noted that in a lockdown period people may not be willing to describe their internal states without the supportive function that the relationship with a clinician can offer. In fact, in order for self-report measures to have good validity, the individuals completing them must be able to accurately assess their internal states; this can limit their utility, especially in clinical populations (64). In future research, utilizing a clinical interview would provide a more accurate assessment of participants' health status.

In addition, the use of the web for data collection, while allowing for contact with the general public during a lockdown period, does limit the findings to the population of individuals who voluntarily participated and does not allow analysis of those who chose not to participate. Moreover, the cross-sectional nature of the study does not allow us to identify cause-and-effect relationships, and for this reason the authors hope to be able to collect data on the psychological health of the sample observed with a follow-up of 6 and 12 months from the first sampling.

The present study presents also some strengths, as the importance of the topic investigated that is aimed to increase the knowledge regarding the impact of both the COVID-19 pandemic and the lockdown rules on psychological health.

A further strength is the focus given to the exploration of the association between the perception of social support and depressive and anxious symptomatology, as regards the clinical and therapeutic relevance of these findings.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics committee of Department of Dynamic and Clinical Psychology, University of Rome, Sapienza. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

RM contributed to all the phases of the study from conception and design of the study, results interpretation, and writing manuscript. AR performed the statistical analysis, contributed to results interpretation, and in writing the manuscript. MD contributed in data analysis, in results interpretation, and in writing the manuscript. GT contributed to conception and design of the study, organized the database. KD contributed in writing and editing of the manuscript. RT contributed to the interpretation of the results and supervision of the work. All authors contributed to manuscript revision, read, and approved the submitted version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Effects of COVID-19 Epidemic Lockdown on Postpartum Depressive Symptoms in a Sample of Italian Mothers

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OPEN ACCESS

Edited by:

Paola Aceto,
Catholic University of the Sacred
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Reviewed by:

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Catholic University of the Sacred
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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 31 July 2020

Accepted: 08 October 2020

Published: 17 November 2020

Citation:

Spinola O, Liotti M, Speranza AM and
Tambelli R (2020) Effects of COVID-19
Epidemic Lockdown on Postpartum
Depressive Symptoms in a Sample of
Italian Mothers.
Front. Psychiatry 11:589916.
doi: 10.3389/fpsy.2020.589916

The extraordinary health emergency of the COVID-19 pandemic represents a new challenge for mental health researchers and clinical practitioners. The related containment measures may be a risk factor for psychological distress and mood disorders, especially in at-risk populations. This study aims to explore the impact of COVID-19 on postpartum depressive symptoms in mothers with children below 1 year of age. An online questionnaire survey was therefore conducted in Italy between May and June 2020. The survey consisted of several self-administered questionnaires: besides some *ad-hoc* questionnaires, the Edinburgh Postnatal Depression Scale (EPDS), the Scale of Perceived Social Support (SPSS) and the Maternity Social Support Scale (MSSS) were used. Two hundred forty-three Italian women were included in the study. The prevalence of postpartum depression symptomatology among mothers was 44%, as measured through the EPDS (cut-off >12). Women who spent the isolation in northern Italy adopted maladaptive coping strategies significantly more than women living in areas at lower risk. The analysis highlighted a significant difference between the group that was not directly affected by the virus and women who have had a direct or indirect contact with it. Besides situational factors specific to the pandemic, the results show that there are some risk factors tied to the personal history of the mother (e.g., having had a previous abortion). These data should inform and enlighten future protocols of intervention.

Keywords: COVID- 19, lockdown, postpartum depression (PPD), mental health, motherhood

INTRODUCTION

Since its outbreak in the beginning of 2020, the COVID-19 epidemic has significantly impacted many countries, with Italy being one of the European nations most affected by it in terms of death-toll and diffusion. Italy has also undergone one of Europe's longest and most severe quarantines, which began at a National level on March the 9th and ended on May the 3rd. The restrictive measures set up to stop the virus have caused the shutdown of all non-essential businesses and services, including schools, daycares, universities, and almost any kind of workplace, forcing Italians to remain confined in their homes for 3 months. This has caused not only serious social isolation and the disruption of daily habits, but often a job loss or a reduction in financial income. These restrictive measures and their effects, on top of the loss of close ones and the indirect exposure to mass trauma through news and social media, have already been

shown to have increased stress, fear, and anxiety among Italians, significantly affecting their psychological well-being, especially in the case of more vulnerable and/or at risks populations (1, 2).

On this subject, a recently published review by Brooks et al. (3) explored the psychological impact of quarantine. The authors identified some important stressors, which included longer quarantine duration, infection fears, frustration, boredom, inadequate supplies, inadequate information, financial loss, and stigma. As far as symptoms are concerned, the review indicates that studies that compared psychological outcomes for people quarantined with those not quarantined (4–6), found that the former were significantly more likely to report exhaustion, detachment from others, anxiety, irritability, insomnia, poor concentration and indecisiveness, deteriorating work performance, trauma-related mental health disorders and depressive symptoms. Likewise, quantitative studies that only surveyed those who had been quarantined (7–10) reported more psychological symptoms, such as emotional disturbance, depression, stress, irritability, insomnia, and post-traumatic stress symptoms. Overall, this data highlights the critic impact of quarantine and isolation on mental well-being. Many researches have pointed out an increase in depressive symptomatology during COVID-19 in the general population, and Davenport et al. (11) have specifically identified an increase in the likelihood of maternal depression, highlighting how mothers could be at a particularly high-risk of developing psychological distress.

Transition to maternity, and specifically gestation of the first child, has been identified as a crucial life event (12). The ease or difficulty in which the woman makes this transition significantly affects her marital relationship and her early interactions with the child (13). Most part of the research carried out on becoming a mother is based on the experience of having the first child. However, some studies (14, 15) pointed out that having additional children leads to similar periods of adjustment (13). Lack of experience and representations restructuring is not the only source of stress during this transition: it seems that the process of having a new member into a pre-existing system is onto itself a source of crisis requiring readjustment (12). Overall, the transition to parenthood encompasses psychological (16), neurobiological (17); and socio-relational adjustments (18, 19). In this context of redefinition, postnatal depression (PND) is a major parental mental health issue (20). Specific risk factors for the insurgence of PND have been identified. Antenatal depression has been found to be the strongest predictor of postpartum depression (21, 22). Likewise, lack of social support, poor marital relationships (21), stressful life events during pregnancy and after delivery (23), and prior negative pregnancy experiences, such as abortion or miscarriage, all have been found to strongly predict postpartum depression (18, 19).

The estimated prevalence of postpartum depression ranges from 6.5 to 12.9% or even higher in lower-income countries (24). Symptoms of postpartum depression often include sleep disturbance, anxiety, irritability, a feeling of being overwhelmed and an obsessional preoccupation with the baby's health and feeding. Suicidal ideation and worries about causing harm to the baby have also been reported (25). Because of assessment reliability issues, the best method for detecting postpartum

depression remains controversial. The term “depression” has been widely used to refer not only to a continuum of depressive mood and psychological distress, but also for a definite diagnostic category (26). Some studies (27) highlighted a prevalence of the latter one of around 10%, while when self-report questionnaires are used the percentage of women with depressive symptomatology is much higher (between 20 and 30%). However, more recently Shorey et al. (28) conducted a review which didn't find a significant difference between prevalence of PPD as diagnosed through self-report questionnaires and clinical interviews. Therefore, screening for PPD through the Edinburgh Postnatal Depression Scale [EPDS; (29)], as recommended by the American Academy of Pediatrics, ultimately seems to be an accurate method of identifying postpartum depression.

Mothers suffering from postpartum depression have been shown to be less sensitive to their infants' needs (30). This has an impact on mother-infant bonding and may also reduce breastfeeding (31). Furthermore, early interaction interferences might impair the cognitive, behavioral, and social-emotional development and physical health of the child (32).

Some research specifically exploring the impact of COVID-19 on maternity has already been carried out. Recently, a study (33) showed an increase in the prevalence of postpartum depression in Chinese women who gave birth during the peak of the COVID-19 epidemic, as measured through the EPDS. Similar results were found in another Chinese research on pregnant women: they showed higher scores at EPDS, high levels of anxiety and a strong tendency to self-harm. These elements appeared to be mediated by the fear of COVID-19 infection (34). Another study carried out by Davenport et al. (11) on mothers who were pregnant or in the first year after delivery found that an EPDS score >13 was self-identified in 15% of respondents before the pandemic and in 40.7% during the pandemic. Also, moderate to high anxiety was identified in 29% of women before the pandemic and in 72% of women during the pandemic. Likewise, Vazquez-Vazquez et al. (35) conducted a study exploring breastfeeding practices during COVID-19 in women living in the UK aged ≥ 18 years with an infant ≤ 12 months of age. They found that lockdown has had an impact on maternal experiences, resulting in distress for many women, and that it affected breastfeeding practices.

So far, the vast majority of studies have been conducted abroad. Since Italy has been severely affected by the virus, there is need for further studies exploring the impact of it on the well-being of mothers. Identifying early risk factors of subsequent potentially dysfunctional interactions is crucial. This work aims to explore how a major critical event such as the one posed by the COVID-19 pandemic interacts with the delicate phase of transition to motherhood (be it for the first time or not).

More specifically, our hypotheses were the following: that during COVID-19 pandemic there would be a higher prevalence of post-partum depressive symptomatology than previously reported in literature; that the coping strategies adopted by each woman, as well as her perceived level of stress and her perceived social support would be correlated to the presence of a depressive symptomatology; and that among women who spent the isolation in the areas with higher rates of COVID-19 infection such symptomatology would be higher. We were also

interested in exploring how some factors related both to the COVID-19 situation (such as an eventual loss of employment or fear of infection) and to the women's personal history could be correlated to the presence of depressive symptoms.

METHODS

Design

This cross-sectional study was conducted online. A survey has been set up through Google Forms. The survey has been online from May 11 to June 6, 2020 and it took ~20–25 min to be completed. Participants could stop the survey at any time and withdraw from the study. Furthermore, participants could interact with the principal investigator of the study through email messages at any time during and after study participation.

The survey addressed women living in Italy at the moment of the lockdown, aged over 18 years, speaking Italian and having a child between 0 and 1 year through a multistep procedure: (1) email invitation to no-profit associations dealing with new mothers; (2) dissemination of the link through social media channels (Facebook, Twitter, Instagram) and the mailing lists of national post-partum depression associations; (3) official communication channels (e.g., University websites; websites of the associations directly involved in the management of postpartum period).

The invitation letter included information on study purposes and confidentiality. The provision of the informed consent was mandatory in order to start the survey.

Measures

Content of the Survey

The survey was designed by the study team who has experience in the field of postpartum depression and mother-child interactions. Questions that could provoke or worsen psychological distress were avoided. The survey included an *ad hoc* schedule with the following sections:

1. socio-demographic characteristics;
2. COVID-19 related factors;
3. Personal history factors and information about pregnancy and childbirth;
4. Support after pregnancy.

Additionally, the survey included the following self-reported questionnaires: the Brief Coping Orientation to Problems Experiences [Brief-COPE; (36)], the Edinburgh Postnatal Depression Scale [EPDS; (29)], the Perceived Stress Scale [PSS; (37)], the Maternity Social Support Scale (38). Respondents' main socio-demographic characteristics, as well as data on their COVID-19 experience (loss of job, infection of themselves or of close others, fear of being infected, instructions about breastfeeding, etc.) was collected through an *ad hoc* schedule.

Demographic Characteristics of Mothers

Demographic characteristics of women who took part to the study, including age, educational level (secondary school, undergraduate degree, master's degree, Ph.D. or postgraduate title), profession (unemployed, student, housewife, freelancer,

occasional job, employee, or other), weeks of the child, civil status and area of Italy of spent isolation were collected.

Personal History Factors

Personal history factors included having had previous abortions, having had childbirth complications, child's health at birth, having breastfed, having had other children and having had previous emotional troubles. Previous emotional troubles were assessed through the question: "Have you ever suffer from emotional troubles?," to which a respondent could respond "yes" or "no".

COVID-19 Related Factors

COVID-19 related factors included: loss of job; received support from family; infection of themselves; infection of close others; fear of being infected; fear of a close one being infected; fear of the child being infected; having received instructions about breastfeeding; believing that COVID-19 has affected breastfeeding.

Perceived Support After Pregnancy

Support after pregnancy was measured using the Maternity Social Support Scale [MSSS, (38)], a self-report questionnaire which consists of 6 items exploring relational factors commonly associated with postpartum depression (family support, support network, help from partner/spouse, conflict with partner/spouse, feelings of being controlled by partner/spouse, and feelings of being loved by partner/spouse), each rated on a 5-point Likert scale. Low scores at the MSSS are significantly related to poorer health conditions and to higher scores at instruments measuring post-partum depressive symptoms (38).

Measurement of Coping Strategies

Use of coping strategies was explored through the Brief COPE (36), a self-reported questionnaire which consists of 28 items involving questions about one's way of coping with stressful situations. Each item is answered on a four-point Likert scale. The questionnaire consists of 14 sub-scales: self-distraction; active coping; denial; substance use; use of emotional support; use of instrumental support; behavioral disengagement; venting; positive reframing; planning; humor; acceptance; religion; and self-blame. The scores obtained at each sub-scale are interpreted referring to two overarching coping styles: avoidant (denial, substance use, venting, behavioral disengagement, self-distraction, self-blame) and approach (active coping, positive reframing, planning, acceptance, seeking emotional support, seeking informational support). Although various categorization systems have been employed, the division in these two dimensions as different—and stable over time—strategies to cope with stress is one of the most utilized in mental health studies (39, 40). The humor and religion sub-scales aren't considered as part of neither an approach nor of an avoidance coping style. The relationships between coping strategies and maternal well-being has already been documented in literature: several studies have in fact found that the use of some particular coping strategies can differentiate between women with or without post-partum depressive symptoms; more specifically, the presence of avoidant coping strategies seem to be able to predict the development of

depressive symptoms among mothers, both during pregnancy and after childbirth (41–45).

Measurement of Perceived Stress

The Perceived Stress Scale [PSS; (37)], was used to measure the perception of stress. This self-report instrument has a total of 10 items asking about one's feelings and thoughts in the past month. Each item is answered on a five-point Likert scale ranging from 0 (never) to 4 (very often). The overall score ranges from 0 to 40, with higher scores indicating higher levels of perceived stress. Scores between 0 and 13 are indicative of no stress, between 14 and 26 of stress, and between 27 and 40 of significant stress. The Cronbach's alpha coefficient for this scale in previous studies was 0.810 (46).

Measurement of Postnatal Depression

Depression symptoms were measured using the Edinburgh Postnatal Depression Scale [EPDS; (29)], a 10-item self-report scale designed to measure self-reported symptoms associated with depression experienced in the past week. Each item was scored using a four-points Likert scale (from 0 to 3). Scores were summed up, with 30 as the highest possible value. High values indicate strong symptoms. Mothers with scores of 13 or higher are regarded as likely to suffer from depression. This questionnaire is widely used to screen for depression, and has a Cronbach's alpha coefficient of 0.79; using a cut-off score of 12, it has good specificity (98.9%) and positive predictive value (90.9%) (47).

Statistical Analysis

SPSS version 25 (IBM, Armonk, NY, United States) was used for analysis. Data are expressed as mean $\pm$ SD or number (percentage). All reported probability values for the *t*-test performed were 2-tailed, and the criterion for significance was set at $p = 0.05$. Descriptive statistics have been processed for the dependent and confounding variables.

Specifically, the analytic plan included: (1) data cleaning of the online dataset; (2) descriptive statistics of the general characteristics of the recruited sample, in terms of levels of depressive symptoms, coping strategies, perceived stress and social support, of closeness to infections and impact of COVID-19 on the socio-economic status, (3) sub-groups analyses based on the level of impact of the pandemic on postpartum depression symptoms. Namely *t*-tests were carried out to test for the effects of the following variables on global EPDS scores: Suspension from work (self or partner), Received economic support from family, Infected by the virus, Infection of close one, Contact with infected ones, Influence of COVID-19 on breastfeeding practices, Fear of being infected, fear of child being infected, Fear of close ones being infected, Previous Abortion, Birth Complications, Breastfeeding, Other children, Previous Emotional Troubles, Child's good health at birth. Two-way Analysis of Variance (2-way ANOVA) were ran in order to test for the interaction between fixed factors but no significant results were found therefore they were not included in the final version of the manuscript. Lastly, bivariate correlation between MSSS, PSS,

TABLE 1 | Sociodemographic characteristics of the sample.

Characteristics	Subgroup	Value	N
Mean age, y	–	34.01	243
Mean child age, wk	–	15.11	235
Area of Italy (spent isolation, %)	North	53.90	131
	Center and South	44.90	109
Level of education (%)	Secondary school	18.85	46
	Undergraduate degree	19.80	48
	Master's degree	34.84	85
	Phd/Postgraduate title	26.30	64
Civil status (%)	Single	5.33	13
	Married/Cohabiting	93.44	227
	Divorced/Separated	0.80	2
	Widowed	0.41	1
Profession (%)	Unemployed	10.30	25
	Student	2.50	6
	Housewife	3.70	9
	Occasional job	2.90	7
	Freelancer	19.8	48
	Employee	55.6	136
	Other	5.30	13

EPDS were carried out, and criterion for significant correlation was set at $p = 0.05$.

RESULTS

Characteristics of the Sample

The sociodemographic characteristics and clinical features of respondents are shown in **Table 1**. Two invalid records were removed. Two hundred forty-three women were included in the study (Age M = 34 years old, range = 21–47; sd = 4.27). Inclusion criteria were: having a child between 0 and 52 weeks of age, being in Italy during the lockdown. Regarding the area in which subjects have been during the lockdown, 53.9% of the sample has been isolated in northern Italy, and 44.90% in central or southern Italy. On average, at the moment of the research the child age was 14.79 weeks old (range = 0–48; sd = 9.12), and 93.4% of women was married or co-living.

As far as personal history data is concerned, results showed that 65% of the sample was having the first child, and 32.1% had had previous abortion. Furthermore, 12.3% of women suffered from previous chronic diseases, and 28.4% declared to have suffered from previous emotional problems.

Regarding situational factors (inherent to the COVID-19 pandemic), 21.0% of the sample had one or more close person infected from the virus, and 3.7% of the women who took part to the survey had been infected. Approximately 62.6% of the sample was afraid of being infected, 83.1% feared that a close one such as their partner could be infected, and 84% of women was afraid that their children could be infected. More than 72% of the sample has had a suspension of the work (own's or partner's job), and 21.0% received economical support from the family.

TABLE 2 | Self-report scales cut-off for clinical significance and % of the sample above cut-off.

Self-report scale	N	Cut-off	% over cut-off	Min-Max	Mean score	Standard deviation
Edinburgh postnatal depression scale (EPDS)	243	>12	44.40	0–26	10.86	6.37
Perceived stress scale (PSS)	243	>27	51.90	14–39	26.65	5.80
Maternity social support scale (MSSS)	243	<18	87.20	6–29	11.51	4.75

TABLE 3 | Effects of COVID-19 related variables on Edinburgh Postnatal Depression Scale (EPDS) total score.

Characteristics		N	Mean	Standard deviation	T	p
Suspension from work (self or partner)	Yes	175	11.50	6.31	2.55	0.01
	No	68	9.21	6.27		
Received economic support from family	Yes	192	12.61	6.25	2.22	0.05
	No	51	10.43	6.34		
Infected by the virus	Yes	9	18.00	7.05	3.5	0.001
	No	234	10.59	6.20		
Infection of close one	Yes	51	13.69	6.80	3.65	0.000
	No	192	10.11	6.05		
Contact with infected ones	Yes	220	16.00	6.45	4.16	0.000
	No	23	15.96	6.59		
Influence of COVID-19 on breastfeeding	Yes	96	14.55	5.97	8.25	0.000
	No	147	8.45	5.41		
Fear of being infected	Yes	152	11.09	5.90	0.733	n.s.
	No	91	10.47	7.11		
Fear of child being infected	Yes	204	11.59	6.29	4.24	0.000
	No	39	7.03	5.41		
Fear of close ones being infected	Yes	202	10.37	5.97	−2.71	0.01
	No	41	13.29	7.72		

Bold values indicates the significant values.

Standardized Questionnaires Global Scores

The most striking result concerns the EPDS total scores (see Table 2 for detailed scores and frequencies). More than 44% of the sample has a score above the cut-off (≥ 12) for postpartum depression symptomatology.

Moreover, 51.90% of the sample had a score above the cut-off for significant stress perceived (> 27), and 87.20% of the sample had a perceived Maternal Social Support of < 18 , indicative of very low support perceived.

Impact of COVID-19 Related Variables on Depressive Symptomatology

Several *t*-tests were ran so to explore the effects of COVID-19 related variables on the prevalence of depressive symptomatology (means, *p*-values, *t* scores and standard deviations are shown in Table 3). Results pointed out a statistically significant effect of having had a suspension from work (own's or other's) and of having received economic support from the family. Also, having been in touch with the COVID-19 had a significant impact on the EPDS scores. More specifically, having been infected by the virus, having had a close one infected or having been in contact with infected ones all had a significant effect on the total score of the EPDS. Likewise, fear for the child being infected also had a significant effect on the postpartum depressive

symptomatology as measured through the EPDS. Surprisingly, women who reported not to be afraid of close ones being infected exhibited higher scores at EPDS scores compared to women who stated to have such fears.

Effects of Personal Variables on Depressive Symptomatology

As far as effects of personal characteristics on the self-report scales are concerned, the *t*-test analysis highlighted that the presence of one or more abortions in women's previous history has a significant effect on depressive symptomatology, with women having had a previous abortion showing higher scores on the EPDS compared to that presented by women without previous abortions.

Likewise, having had previous emotional problems also had a significant effect on the EPDS scores. Having other children, birth complications, breastfeeding practices and child's health at birth didn't have a significant effect on the scores at the different scales. (Tables 4, 5).

Correlation Between Self-Report Scales and EPDS Scores

Correlational analysis were ran for continuous variables (see Table 6 for Pearson correlation values and significance). Results showed a statistically significant positive correlation between

TABLE 4 | Effects of women's personal characteristics on Edinburgh Postnatal Depression Scale (EPDS) total score.

Characteristic		<i>N</i>	Mean	Standard deviation	<i>t</i>	<i>P</i>
Previous abortion	Yes	78	13.64	6.14	4.84	0.001
	No	165	9.59	6.07		
Birth complications	Yes	63	11.95	6.44	1.58	n.s.
	No	180	10.48	6.32		
Breastfeeding	Yes	197	10.73	6.16	−0.65	n.s.
	No	46	11.41	7.25		
Other children	Yes	85	10.53	6.14	−0.64	n.s.
	No	158	11.04	6.50		
Previous emotional troubles	Yes	69	12.74	6.20	2.94	0.001
	No	174	10.11	6.30		
Child's good health at birth	Yes	219	10.84	6.32	−0.126	n.s.
	No	24	11.04	6.94		

Bold values indicates the significant values.

TABLE 5 | Areas of Italy and BRIEF-COPE avoidant strategies.

Sub-scale	Area	<i>N</i>	Mean	Standard deviation	<i>t</i>	<i>p</i>
Substance abuse	Center and South	109	4.78	1.49	−2.50	0.01
	North	131	5.18	1.45		
Self distraction	Center and South	109	4.78	1.49	−2.21	0.04
	North	131	5.17	1.45		
Denial	Center and South	109	3.12	1.43	−0.65	n.s.
	North	131	3.23	1.33		
Venting	Center and South	109	5.08	1.76	−0.48	n.s.
	North	131	5.18	1.44		
Behavioral disengagement	Center and South	109	2.97	1.27	−0.32	n.s.
	North	131	3.02	1.17		
Self blame	Center and South	109	5.08	1.45	−0.72	n.s.
	North	131	5.23	1.35		
Total avoidant style	Center and South	109	23.17	4.46	−1.83	n.s.
	North	131	24.17	4.01		

Bold values indicates the significant values.

TABLE 6 | Correlation of edinburgh postnatal depression scale (EPDS) score with perceived stress scale (PSS), maternal social support scale (MSSS) and brief coping orientation to problems experiences (BRIEF-COPE) scores.

Self-report scale	<i>r</i>	<i>p</i>
Perceived stress scale (PSS)	0.774	0.001
Maternity social support scale (MSSS)	0.410	0.001
BRIEF-COPE (Avoidant Strategies)	0.356	0.001
BRIEF-COPE (Approaching Strategies)	−0.135	0.037

Bold values indicates the significant values.

the scores at the EPDS and SPS scores, avoidant strategies as measured through the BRIEF-COPE scales and MSSS scores. Statistically significant negative correlations were found between EPDS scores and approaching strategies (measured through the BRIEF-COPE).

Effect of Area of Spent Isolation

In order to further explore the specific impact of the area of isolation (north vs. center and south) the sample was divided into two groups depending on the area where they spent the isolation (North: Piemonte, Liguria, Veneto, Friuli Venezia Giulia, Trentino Alto Adige, Emilia Romagna e Lombardia) Center and South (Lazio, Toscana, Puglia, Abruzzo, Basilicata, Calabria, Campania, Sicilia, e Marche). A *t*-test was then carried out to see whether there was a difference in terms of EPDS scores between northern areas and central and southern ones. We decided to divide the sample in these two groups, considering central and southern areas as a whole, because in those areas the risk of contagion and the diffusion of the virus was similar, and significantly lower than in the north (48).

Results pointed out a significant effect of the area of isolation on total EPDS scores, with northern areas having higher means (see **Table 7** for means and Standard Deviations). A similar result

TABLE 7 | Areas of spent isolation and Edinburgh Postnatal Depression Scale (EPDS) scores.

Area	N	Mean	Standard deviation	t	p
North	131	11.85	6.56	−2.50	0.01
Center and South	109	9.82	5.94		

TABLE 8 | Areas of spent isolation (South, Center and North of Italy) and PSS scores.

Area	N	Mean	Standard deviation	t	p
North	132	27.77	5.62	−3.01	0.003
Center and South	109	25.58	5.62		

was found for the scores at the Perceived Stress Scale, with northern areas exhibiting significantly higher stress scores.

Lastly, we wanted to understand whether there was a difference in terms of coping strategies between northern areas of Italy and central and southern. We therefore carried out further *t*-tests which highlighted a significant difference between these areas only for the scales measuring Substance Abuse and Self Distraction, both being part of dysfunctional coping strategies (see **Table 8** for means and Standard Deviations).

DISCUSSION

This study investigated the impact of COVID-19 pandemic on the psychological well-being of mothers of children aged from 0 to 1 year old. An EPDS score of >12 (indicative of postpartum depression symptomatology) was self-reported in 44% of the sample. Likewise, a perceived stress of >27 (indicative of a substantial stress perceived) was self-reported in 43.4% of the sample. These findings illustrate a significant increase in depressive symptomatology and stress in mothers during the pandemic compared to the self-reported rates of depressive symptomatology in the general population.

Several COVID-19 related variables showed to have a significant effect on the EPDS scores. Specifically, a significant effect of fear of infection (for others and child) on EPDS scores was found. Women who reported to be scared of having their own child infected, reported higher levels of depressive symptomatology compared to women who didn't state to have such fears. This is coherent with the results of a recent study published by Dsouza et al. (49) about the causative factors of COVID-19 related suicide-incidence. The authors found fear of COVID-19 infection to be the prominent causative factor of COVID-19 related suicides, and they hypothesize a relationship with the lack of literacy and the presence of a stigma around mental health in rural areas in India, where the study was carried out. This is an important result because it suggests that a lack of appropriate information about the COVID-19 could play an important role in increasing levels of fear, anxiety, depression

and other symptoms. However, it is important to notice that women who reported not to be afraid of close ones being infected exhibited higher scores at EPDS compared to women who didn't report such fears. It could be speculated that use of strategies such as denial of anxious internal states may increase the depressive symptomatology, but the sole use of a self-report scale to measure depressive symptomatology calls for further exploration of the afore-mentioned effect.

Relevantly, in our survey some women reported to have received indication of breastfeeding their child with the mask during the COVID-19 pandemic by their physicians. This kind of information might have contributed to fear of infection and of infecting the child. In fact, a striking result is that women did not report fear of infection for themselves, but only for their children or significant others around them. Coherently with this hypothesis, another factor that had a significantly influence on the EPDS scores in our study was indeed the belief that COVID-19 has affected breastfeeding practices, reported by around 61% of women in our sample.

Besides, having had a close one infected by the virus also significantly increased the EPDS scores. This influence appears rather intuitive, since having close ones infected is likely to increase fear of loss and psychological burden of the pandemic. Also having been in contact with someone who had been infected increased the self-reported post-depression symptomatology. Having been in touch with a COVID-19 positive person might have increased the fear of infecting the child and of being harmful to the child, thus lessening the self-efficacy and sense of adequacy as a new mother.

Regarding the socio-economic impact of COVID-19 on the mother, a decrease in income of the mother or of the father of the child was significantly associated with higher scores at the EPDS. This result is in concordance with an earlier review conducted which found decreased socioeconomic status to significantly increase the risk for postpartum depression (50).

Interestingly, receiving economic support from the family significantly increased the EPDS scores. We can only speculate about what causes women receiving economical support to experience higher symptoms of postpartum depression. One possible explanation could be that receiving support affects the perception of one's self as competent and self-efficient, and therefore reduces the self-esteem of the new mother.

Not surprisingly, women who spent the isolation in northern areas of Italy—which have been most severely affected by the virus in terms of death toll and contagions—reported higher levels of postpartum depression symptomatology and of perceived stress than women who spent the isolation in central or southern areas of the country.

Beyond COVID-19 related factors, some specific characteristics belonging to the personal history of the mother also had an effect on the depressive symptomatology. Namely, having had a previous abortion significantly increased the likelihood of developing postpartum depression. The role of previous abortion as a potential risk factor for the onset of postpartum depression, despite being quite intuitive, has not been extensively documented in the literature. A review from Hamama (51) found a rate of PTSD during the subsequent

pregnancy of women who had an abortion of 12.6%, and the rate of depression was 16.8%, as assessed through phone clinical interviews. However, the detailed analysis of the association of past abortions with subsequent pregnancy mental health status indicated that it was not the experience of abortion itself that increased the risk of PTSD or depression, but the appraisal of the abortion as having been a hard time (i.e., potentially traumatic) that predicted subsequent morbidity. Despite there being existing evidence showing the association between abortion and increase in risk of mental disorders (52), further research is needed to elucidate the specific mechanisms underlying the effects of previous abortions on subsequent pregnancies. This is a fundamental aspect to control for since it represents a potential risk factor for increased vulnerability of the mother.

Having had previous psychiatric history also had a significant effect on the EPDS total scores, with women having a history of emotional troubles exhibiting higher scores. This is a risk factor which has already been documented in the literature (53), hence highlighting the importance of a correct screening procedure including questions relating to previous psychiatric history. Another interesting finding was observed regarding coping strategies. Significant differences between northern and central/southern areas were found for the scales of Substance abuse and Self-distraction, both part of the avoidant strategies, higher in the north. Previous studies have already found that an avoidant coping strategy is related to more symptoms of depression (40). More specifically, women with passive coping strategies (i.e., with higher scores on the denial, behavioral disengagement, self-blame and substance abuse scales) have been found to be more at risk of developing symptoms of antenatal and/or postnatal depression (41–45). Exploring the link between coping styles, post-traumatic stress and depressive symptoms in a sample of new mothers, another study found that self-distraction strategies were positively correlated with a depressive symptomatology (54). Targeting coping strategies in the intervention could be therefore particularly useful to reduce the depressive symptomatology in at-risk mothers.

Overall, the results of this study have a clinical relevance. Even though clinical diagnosis through psychiatric interviews remain elective, this study remarks a significant postpartum depressive symptomatology increase in women with children below 1 year. Throughout periods of confinement and of restrictions, follow-up should therefore be as close as possible, and the administration of a questionnaire specifically exploring the presence of personal and situational risk factors could be extremely useful. If postpartum depression is a multifaceted disorder which results from a dynamic interaction between biological, psychological, and social risk factors, the current COVID-19 pandemic likely has amplified them all (55). The severe consequences of postpartum depressive symptomatology on the mother-infant bonding and global development of the child are now widely documented in the literature (56) and calls for a thorough and specific attention. Having identified some of the potential risk factors associated with the onset of a pandemic is of crucial importance so to inform clinical practices

and develop prevention programs aiming to support this at-risk population.

LIMITATIONS AND FUTURE DIRECTIONS

Limitations

There are several caveats to consider when interpreting the results of this study. First of all, women having pre-existing interest in mental health or experiencing distress might have been more likely to respond to take part to this survey, thus potentially rendering the sample not fully representative of the general population. Furthermore, past studies highlighted that the quality of response in online surveys tends to be reduced (57). This is even more problematic considering the small size of the sample of this survey, which might contribute to an underpower of the statistically significant results of this study. Another limitation resides in the use of a self-report instrument to evaluate the presence of a post-partum depressive symptomatology among women, such as the EPDS. Although the questionnaire has proven to be effective to identify the presence of PPD (28), an actual diagnosis could only be obtained through a clinical interview performed by a licensed health-care professional. Lastly, the correlational nature of the study doesn't allow to establish a causal relationship between the variables but only permits to infer correlations between them.

Future Directions

The long-term significance of these findings for mother-infant interactions and subsequent outcomes still has to be explored. Since a large part of the sample gave its consent to be contacted for a second part of the study, future studies could investigate the impact of COVID-19 on mother-child interactions and on child's global development in a longitudinal perspective. A further question to be explored is whether these COVID-19-related depressive symptoms are somehow comparable to depressive states of other nature.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of Sapienza Università di Roma. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

The data were collected by OS, and ML, while data analysis was conducted by AS, OS and ML. All authors study was designed contributed, writing of the manuscript, read and approved the final manuscript.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The reviewer, DA, declared a past co-authorship with one of the authors, RT, to the handling Editor.

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Loneliness and Social Distancing During the COVID-19 Pandemic: Risk Factors and Associations With Psychopathology

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OPEN ACCESS

Edited by:

Andreas Maercker,
University of Zurich, Switzerland

Reviewed by:

Maarten C. Eisma,
University of Groningen, Netherlands
Christine Dworschak,
University of Zurich, Switzerland

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 12 August 2020

Accepted: 27 October 2020

Published: 20 November 2020

Citation:

Hoffart A, Johnson SU and
Ebrahimi OV (2020) Loneliness and
Social Distancing During the
COVID-19 Pandemic: Risk Factors
and Associations With
Psychopathology.
Front. Psychiatry 11:589127.
doi: 10.3389/fpsy.2020.589127

Background: The mitigation strategies employed against the COVID-19 pandemic have severe mental health consequences. In particular, as a result of the social distancing protocols, loneliness is likely to increase. This study investigates (a) potential risk and resilience factors for loneliness in the Norwegian population during the strict social distancing non-pharmacological interventions (NPIs) implemented against the pandemic and (b) the associations between loneliness and psychopathology symptoms.

Methods: A survey was disseminated online to the adult Norwegian population when strict social distancing measures had been implemented for 2 weeks. The resulting sample of 10,061 respondents was unproportionate in terms of gender and educational level and thus sensitivity analyses were conducted. The levels of loneliness were compared across demographic sub-groups, and regression analyses were conducted to identify potential risk and resilience factors for loneliness and associations between loneliness and psychopathology symptoms.

Results: Among the stable factors, being single and having a psychiatric diagnosis were related to more loneliness with small effect sizes. Among the state risk factors, more rumination and worry in general were associated with stronger loneliness, showing a medium effect size. Among the coping behaviors examined, doing new things at home not done otherwise was negatively related to loneliness, with a small effect size. Loneliness was associated with both depression and anxiety with small effect sizes when all potential confounders and psychiatric diagnosis were controlled for. The relationship to depression was more marked than the relationship to anxiety.

Conclusions: The findings suggest that singles and those with a psychiatric diagnosis were most affected by loneliness during the implementation of social distancing measures to impede the coronavirus. The results support the link between loneliness and depression and anxiety symptoms. The results of the analysis of potential risk and resilience factors point to intervention targets for reducing loneliness during pandemic crises.

Keywords: loneliness, risk factors, resilience factors, depression, anxiety, COVID-19, social distancing measures

INTRODUCTION

The coronavirus disease 2019 (COVID-19) is now a full-blown pandemic with strong effects on global public health (1). While awaiting the development of an effective vaccine, many countries have implemented non-pharmacological interventions (NPIs) involving a variety of social distancing measures to limit the spread of the virus (1).

The pandemic and social distancing protocols used to impede the virus have severe mental health consequences (2). In particular, loneliness is likely to increase, as has been documented during previous pandemics (3). Loneliness can be defined as an unpleasant state of sensing a discrepancy between the desired amount and quality of social interaction and that which is available from the person's environment (4). This definition underscores the fact that feeling alone or lonely depends on one's personal standards for a satisfying social connection and thus does not necessarily mean being alone nor does being alone necessarily mean feeling alone. Thus, social isolation and loneliness are different concepts. However, the social distancing measures restrict the availability of social contact by isolating individuals and families in their homes and separating them from colleagues, friends and relatives. Thus, the NPIs may intensify pre-existing loneliness and elicit detrimental levels of loneliness in individuals not particularly affected by this problem before the NPIs were implemented (2). Loneliness is characterized by a painful state with large neurological similarities to physical pain, with findings revealing similar somatosensory representations in the brain between physical pain and social rejection (5). Loneliness is associated with suicidal ideation and parasuicidal behavior (6) and contributes to a range of somatic (e.g., cardiovascular diseases, hypertension) and mental (e.g., depression, anxiety) conditions (7). Thus, loneliness is linked to overall morbidity and mortality (8). Both objective social isolation and subjective loneliness have been found to increase mortality by about 30% (8), and recent reports indicate that loneliness is now the most lethal problem in Great Britain (9). Consequently, increased loneliness due to the social distancing measures represents a serious mental health problem, and it may contribute in particular to increased depression and anxiety. Moreover, NPI-related loneliness, depression and anxiety may continue even after the social distancing measures are lifted because of self-sustaining feedback between the symptoms of these states (10). For instance, it is known that triggering events can cause loneliness and depression long after the triggers have disappeared (11). Indeed, studies from previous pandemics have indicated the long-term impacts of mitigation strategies such as quarantine on mental health and behavior (12).

Many stable risk factors for experiencing loneliness during the NPIs are those found for experiencing loneliness in general. With respect to age, studies have indicated that loneliness decreases

across the life span (13). Other studies have evidenced a more complex trajectory, showing elevated levels among the youngest and oldest adults (14). Lower socioeconomic status, which is closely related to educational level, not actively working and being single have all been found to increase the risk of loneliness (15). Adults with mental disorders have also proved to have increased loneliness (16). For other stable factors, the evidence base is more uncertain. One meta-analysis showed gender to be unrelated to loneliness (17). However, other studies have found loneliness to be stronger among women (18). Not having children has also been proposed as a risk factor, but this hypothesis has received mixed support (18, 19). Being a refugee in a new foreign country could also lead to loneliness, but this situation has been less studied. Thus, among the stable factors, being younger, single, less educated, unemployed and having a psychiatric diagnosis have all been supported as risk factors for loneliness, whereas the evidence for being female, childless and a refugee is mixed or lacking.

Loneliness is also likely to be influenced by specific state variables related to the pandemic and NPIs. The pandemic will naturally elicit more worry and anxiety about health (20). Moreover, NPIs have many work-related and economic consequences such as the shutdown of enterprises and factories and the laying off and dismissal of employees, leading to widespread uncertainty about one's private economy and job. Thus, the pandemic and the NPIs involve many losses and uncertainties with previous pandemics revealing increases in rumination and worry (20). These perseverative thinking activities are likely to increase loneliness in several ways. First, incessant rumination, worry and reassurance-seeking often become frustrating for others and may result in considerable strain within the family, thus, increasing feelings of loneliness (21). Second, rumination and worry take up time and promote an inward focus that interferes with attention to other people and leads to loss of contact with others and reduced social activity (22). Third, rumination typically leads to views that the situation is hopeless and that nothing can be done to overcome it (21). For instance, individuals brooding about their loneliness may lead to the conclusion that seeking contact will fail. Worry increases appraisals of the probability and cost of negative outcomes of future events (e.g., "They will reject me,") (23). Both of these internal activities may provide reasons for behavioral withdrawal, leading to less access to experiences that could disconfirm the very thoughts strengthened by rumination and worry. The results of these processes are likely to be increased feelings of loneliness, depression, and anxiety. In sum, rumination and worry may promote loneliness through several mechanisms, including strain in close relationships, loss of contact with others, and behavioral inactivity that hinders access to corrective experiences. Depression and anxiety may be parallel effects of these mechanisms (24), but they may also more directly affect and be affected by loneliness (21). Empirically, associations between rumination and reduced social support have been found among bereaved adults (25) and between rumination and loneliness among students (26). Consequently, among state variables affected by the pandemic and the NPIs, rumination and worry—both in general and specifically related to uncertainty about health, work and economy—are likely to amplify loneliness.

Abbreviations: COVID-19, coronavirus disease 2019; NPIs, non-pharmacological interventions; H, hypothesis; ULS-8, UCLA Loneliness Scale-8; PHQ-9, Patient Health Questionnaire-9; GAD-7, Generalized Anxiety Disorder-7; HAI, Health Anxiety Inventory; CAS-1, Cognitive Attentional Syndrome-1; *M*, mean; *SD*, standard deviation; *N*, number; *B*, regression coefficient; *SE*, standard error; β , standardized regression coefficient; R^2 , coefficient of determination; *r*, Pearson's correlation; OECD, Organization of Economic Co-operation and Development.

However, loneliness may be mitigated by behaviors designed to cope with the home-based isolation situation following implementation of the NPIs. The present pandemic situation provides individuals with opportunities to do positive things at home not done during non-pandemic everyday life and leaves time to go out and experience nature. These activities may bring about a sense of connection with someone or something and thus reduce loneliness (27).

This study thus investigates (a) the risk and resilience factors proposed above for loneliness in the general adult population during the strict social distancing NPIs implemented in Norway from March 12th 2020 against the COVID-19 pandemic and (b) the associations between loneliness and psychopathology symptoms. The implemented NPIs included not leaving home unless necessary, home isolation if infected, quarantine after exposure to possible infection, closure of kindergartens, schools, universities, and other public spaces, restrictions on traveling, and prohibitions of social gatherings and arrangements. At the first day of the data collection (March 31st), the total number of infected cases was 4,641 of a population of 5.4 millions and the number of new cases that day was 196. At the last day of the data collection (April 7th), the number of new cases was 221 (28). An investigation of the associations of loneliness with potential risk and resilience factors and other psychopathology provides a foundation for employing interventions that protect the general public against increased distress and dysfunction during the pandemic.

The following are the hypotheses (Hs) of the present study:

- H1: Stable risk factors, such as lower age, lower educational level, not being married or in a civil union, not being in work and having a psychiatric diagnosis will be associated with more loneliness during the NPIs. The relationships between loneliness and gender, not having children, and being a refugee will be investigated exploratively.
- H2: Of the state factors related to the pandemic and the NPIs, worry about jobs and/or the economy, worry about health (health anxiety), and worry and rumination in general will be associated with more loneliness, above and beyond the influence of the pre-existing stable risk factors.
- H3: Doing new positive activities at home and experiencing nature will be associated with less loneliness when the influence of stable and state risk factors are controlled.
- H4: Elevated loneliness will be associated with more depressive and anxiety symptoms.

Because variables related to loneliness may confound the relationship between loneliness and psychopathology symptoms, the variables showing significant associations for Hypotheses 1–3 will be controlled for. The presence of psychiatric diagnosis as an indicator of pre-NPI symptoms will be used as a covariate, irrespective of whether it is supported in Hypothesis 2.

MATERIALS AND METHODS

Study Design and Participants

The design was a cross-sectional and epidemiological survey of the general adult Norwegian population during the COVID-19

pandemic. Eligible participants were all individuals aged 18 years and above who were living in Norway and thus experiencing identical NPIs, and who had provided informed consent to participate in the study. The period of data collection lasted seven days between March 31st 2020 and April 7th 2020. The NPIs were implemented from March 12th 2020 and held constant during the 2 weeks prior to data collection and during the data collection week. Furthermore, no new information was given by the government during this period with regard to changes in the NPIs, keeping expectation effects constant. The number completing the survey was 10,084. When re-contacted for further measurement, 23 out of these 10,084 participants requested to be removed from the study and not contacted further. In accordance with the General Data Protection Regulation law in Norway, use of the data of these 23 participants is precluded. Consequently, the overall sample size was updated from 10,084 to 10,061 participants.

The study was conducted in accordance with the guidelines of the Strengthening the Reporting of Observational Studies in Epidemiology statement (29). Ethical approval of the study was granted by the Regional Committee for Medical and Health Research and the Norwegian Centre for Research Data (reference numbers: 125510 and 802810, respectively) prior to data collection. The pre-registered protocol of this study can be found at Clinicaltrials.gov (Identifier: NCT04365881). Because of the sudden onset of the pandemic and the need for immediate observation of mental health reactions, we were unable to pre-register prior to data collection. Thus, we had access to the data at the date of registration, though no analysis was conducted related to the research plan. All elements of the submitted study adhere to the pre-registered protocol. The study is part of the Norwegian COVID-19 Mental Health and Adherence Project (30).

Procedures

The survey was disseminated online in a systematic manner to give the adult population an equal opportunity to participate in the study. The dissemination procedure involved information about the survey through broadcasting on national, regional and local news channels and the provision of the online survey to a random selection of Norwegian adults on Facebook. The procedure is described in detail elsewhere (30).

The stopping rule for data collection was designed to ensure that the NPIs were held constant for 2 weeks prior to and the week during the data collection period, as well as controlling for expectation effects by stopping the data collection instantly once information concerning forthcoming modifications to the NPIs was given.

Measures

The participants were asked to report the demographic variables of sex (male, female, transgender, intersex), identification with biological sex, age, education (not completed junior school, completed junior school, completed high school, currently studying, completed university degree), being a refugee, civil status (married, living in a civil union, single), number of children, employment status and presence of psychiatric

diagnosis. Questions about suspecting being infected and about time staying home and reasons for this were included.

The UCLA Loneliness Scale-8 (ULS-8) (31) measures the frequency and intensity of aspects of loneliness, using a 1 (*never*), 2 (*rarely*), 3 (*sometimes*) and 4 (*often*) scale. A composite score was computed by summing the items after reverse coding when appropriate, with composites ranging from 8 to 32. The ULS-8 has demonstrated good psychometric properties (31, 32) and had a satisfactory internal consistency–Cronbach's α of 0.82–in the present sample.

The Patient Health Questionnaire-9 (33) consists of nine items covering the DSM-IV criteria for major depression scored on a four-point scale ranging from 0 (*not at all*) to 3 (*almost every day*) with total scores ranging from 0 to 27. The PHQ-9 has revealed good psychometric properties (33) and had a Cronbach's α of 0.88 in the present sample.

The Generalized Anxiety Disorder-7 (GAD-7) (34) consists of seven items covering the DSM-IV criteria for GAD scored on a four-point scale ranging from 0 (*not at all*) to 3 (*almost every day*) with total scores ranging from 0 to 21. The GAD-7 has revealed construct validity and reliability (34) and had an α of 0.88 in the present sample.

Symptoms of health anxiety were measured with two items from the validated Health Anxiety Inventory (HAI) (35)—Item 1: “I constantly have images of myself being ill” and Item 6: “I spend much of my time worrying about my health”—as well as an item measuring specific fear of being infected with coronavirus and an item measuring fear of dying from the coronavirus. These items are rated on a scale ranging from 0 (*never*) to 3 (*almost every day*) asking about symptomatology for the last 2 weeks. The sum score of these items had an α of 0.79 in the present sample.

Current worry about job and economy was measured by the items: “I am worried that I will lose my job” and “I am worried about my economy,” using a scale ranging from 0 (*never*) to 3 (*almost every day*). A general worry and rumination item was taken from the Cognitive Attentional Syndrome-1 (CAS-1) (36, 37): “How much time in the last week have you found yourself dwelling on or worrying about your problems? (0–8 Likert-type scale). Two coping behaviors were assessed: time being engaged in positive activities one would otherwise not have the time for during the non-pandemic everyday life and time spent experiencing nature.

Statistical Analyses

The statistical analyses were conducted in the SPSS program version 25.0 (38). Hierarchical regression analyses were conducted using loneliness as the dependent variable. The first step examined the stable factors: age, gender, civil status, employment status, being a refugee, having children, and having a psychiatric diagnosis (H1). The second step added the NPI-related state variables worry about job and/or economy, health anxiety, and rumination and worry in general (H2). The final step incorporated the coping behaviors of doing new things and experiencing nature (H3).

Two separate hierarchical linear regression analyses were conducted using depressive symptoms (PHQ-9) and anxiety symptoms (GAD-7) as dependent variables (H4). In both

analyses, the variables significantly predicting loneliness in the analyses of H1, H2, and H3 were included to control for potentially confounding factors. The presence of psychiatric diagnosis was also included as an indicator of pre-NPIs symptoms.

In all regression analyses, multicollinearity and other assumptions were checked, particularly if the multicollinearity assumption was violated (if VIF > 3 and tolerance < 0.2) (39). Given the large sample size in this study, we chose the conservative level of $p < 0.001$ to determine significance. Effect sizes were estimated using part (semi-partial) correlations. A part correlation gives a less biased and more interpretable estimate of the strength of a predictive relationship than the standardized regression coefficients and the partial correlation coefficients (40). A part correlation is the correlation between the outcome and the aspects of the predictor unique from all the other predictors. As a type of correlation, its size can be evaluated according to Cohen's (41) criteria: small ≥ 0.10 , medium ≥ 0.30 , and large ≥ 0.50 . A simple correlation size of 0.30 is usually used as the threshold of clinical relevance (42). However, as part correlations were used here, for which many potential confounders were controlled, we used the more lenient level of 0.20 for clinical relevance. There were no data missing in our set because the online survey system comprised only mandatory fields of response.

RESULTS

Characteristics of Participants and Proportional Representation

National NPIs were employed in Norway from March 12, 2020, and the data collection in this study was conducted between March 31, 2020 and April 7, 2020. Consequently, at the time of measurement, the duration for which the respondents experienced NPIs ranged from 19 to 26 days. The 10,061 participants were aged 18–86 years, giving a mean age of 36.0 years ($SD = 13.5$). **Table 1** reports the distribution of participants across age groups and other categorical variables. In terms of a proportional representation of the Norwegian population, more females (7,851, 78.0%) than males (2,184, 21.7%) responded. The sample was also not representative in terms of educational level, as 5644 (56.1%) had completed a university degree, compared to about 34.1% of the population (43). The proportion having a psychiatric diagnosis was 1,721 (17.1%) of 10,061, which reflects the lower end of the known 1-year prevalence of 16.7% to 25.0% in the adult population of Norway (44). The sample was further geographically representative of Norway, with the ratio of individuals from each region being reasonably proportionate to the population parameter. The percentage of people living in Eastern Norway is 58.3%, compared to 63.0% of the respondents who lived there (43). The corresponding numbers were 20.3 and 24.9% for Western Norway, 16.0 and 10.5% for Middle Norway, and 5.5 and 3.6% for Northern Norway.

Of the 10,061 participants, 3,583 (35.6%) reported suspecting being infected by COVID-19 during the 2-week period, 3,399 (33.8%) reported worries about losing their job and 5,920 (58.8%)

TABLE 1 | Levels of loneliness (ULS-8) during a 2-week period under non-pharmacological interventions (NPIs) related to the COVID-19 pandemic.

Variables and categories	N	Mean (SD)	Test
All participants	10,061	17.51 (4.90)	
Sex			
Female	7,851	17.73 (4.82)	
Male	2,184	16.70 (5.09)	
Transgender	22	19.91 (4.75)	
Intersex	4	15.00 (4.24)	$F^a = 40.52, p < 0.001$
Identification with sex			
No	51	19.80 (4.52)	
Yes	10,010	17.50 (4.90)	$t = 3.35, p < 0.001$
Age groups			
18–30	4,706	17.75 (4.75)	
31–44	2,849	17.75 (4.93)	
45–64	2,142	16.93 (5.10)	
65+	364	15.93 (4.85)	$F = 28.88, p < 0.001$
Educational level			
High school or lower	4,417	18.05 (5.00)	
University degree	5,644	17.08 (4.78)	$t = 9.90, p < 0.001$
Partnership status			
Unmarried or not in a civil union	5,310	18.36 (4.94)	
Married or in a civil union	4,751	16.56 (4.68)	$t = 18.71, p < 0.001$
Employment status			
Currently unemployed	1,921	19.07 (5.30)	
Currently employed	8,140	17.14 (4.73)	$t = 15.67, p < 0.001$
Refugee status			
Refugee	574	17.64 (4.98)	
Not refugee	9,487	17.50 (4.90)	$t = 0.52, ns$
Children			
Not having children	5,808	17.86 (4.83)	
Having children	4,253	17.04 (4.96)	$t = 8.34, p < 0.001$
Psychological diagnosis			
Having a diagnosis	1,721	20.77 (4.97)	
Not having a diagnosis	8,340	16.84 (4.61)	$t = 31.75, p < 0.001$

ULS-8, UCLA Loneliness Scale-8.

^aIntersex participants not included in the analysis because of few in number.

reported worries about their personal economy. The majority ($n = 7,952, 79.0\%$) of the participants had stayed home most of the days (at least 10) of the last two weeks, 1,429 (14.2%) had been in home isolation or quarantine because of potential or proved infection, 693 (6.9%) had stayed home because of the closure of their enterprise and 854 (8.5%) had been assigned to a home office by their employer.

Levels of Loneliness Across Demographic Subgroups

Table 1 provides descriptive statistics of loneliness across different subgroups and presents the results of the statistical tests, which indicate that female participants were more lonely than male and transgender participants and that young (18–30 years) and young to middle aged (31–44 years) participants were more

TABLE 2 | Results of multiple regression with loneliness (ULS-8) as the dependent variable.

Variables	B	SE	β	t	Part r	R ²	ΔR^2
Step 1. Stable risk factors						0.13	0.13*
Male	−0.66	0.11	−0.06	−5.79*	−0.05		
Transgender or intersex	−0.67	0.90	−0.01	−0.75	−0.01		
Age	−0.03	0.01	−0.08	−5.68*	−0.05		
Educational level	−0.15	0.10	−0.02	−1.50	−0.01		
Married or in a civil union	−1.60	0.11	−0.16	−15.25*	−0.14		
Employed	−1.36	0.13	−0.11	−10.61*	−0.10		
Refugee	0.29	0.20	0.01	1.48	0.01		
Having children	0.33	0.13	0.03	2.55	0.02		
Psychological diagnosis	3.37	0.13	0.26	26.46*	0.25		
Step 2. State risk factors						0.30	0.17*
Worry about job and economy	0.28	0.03	0.10	10.95*	0.09		
Health anxiety	0.10	0.02	0.05	5.07*	0.04		
General rumination and worry	0.91	0.02	0.38	37.15*	0.31		
Step 3. Coping behaviors						0.32	0.02*
Doing new things at home	−0.66	0.05	−0.12	−14.07*	−0.12		
Experience nature	−0.23	0.04	−0.05	−5.23*	−0.04		

ULS-8, UCLA Loneliness Scale-8.

* $p < 0.001$.

lonely than middle aged to old (45–64 years) and old (65+) participants. Those who did not identify with their biological sex had higher loneliness scores than those who did, those with an educational level of high school or lower had higher loneliness scores than those with a university degree, those living alone had higher scores than those who were married or in a civil union, unemployed attained higher loneliness scores than employed, and those not having children scored higher than those with children. Finally, those with a psychiatric diagnosis had markedly higher loneliness scores than those without a diagnosis.

Correlates of Loneliness

Table 2 presents the results of the multiple regression analyses for loneliness as the dependent variable. In the first step that examined the stable variables, the regression model accounted for 13% of the variance in loneliness, adjusted $R^2 = 0.13$. Being male was a significant correlate of loneliness, with men having lower levels of loneliness than women and than transgender and intersex counted together. Being transgender or intersex did not differ from males and females counted together. Increased age and higher education were associated with decreased loneliness. Being employed and being married or in a civil union were both associated with lower loneliness. Being a refugee and not having children were unrelated to loneliness. Having a psychiatric diagnosis was associated with more loneliness. Of these stable factors, civil status and psychiatric diagnosis attained a clinically significant effect of small size (part $r \geq 0.10$). The other effects were negligible.

In the second step, which added state variables, the model explained 30% of the variance in loneliness, adjusted $R^2 = 0.30$. More worry about job and economy, more health anxiety and

TABLE 3 | Results of multiple regression with depression (PHQ-9) as the dependent variable.

Variables	<i>B</i>	<i>SE</i>	β	<i>t</i>	Part <i>r</i>	<i>R</i> ²	ΔR^2
						0.62	0.62*
Male	−0.64	0.09	−0.05	−7.27*	−0.05		
Age	−0.06	0.00	−0.13	−18.21*	−0.11		
Married or in a civil union	−0.43	0.08	−0.04	−5.73*	−0.04		
Employed	−0.58	0.10	−0.04	−5.88*	−0.04		
Psychological diagnosis	2.39	0.10	0.16	22.92*	0.14		
Worry about job and economy	0.26	0.02	0.08	11.57*	0.07		
Health anxiety	0.16	0.02	0.07	9.42*	0.06		
General rumination and worry	1.14	0.02	0.42	50.88*	0.31		
Doing new things at home	−0.52	0.04	−0.08	−12.71*	−0.08		
Experience nature	−0.23	0.04	−0.04	−6.12*	−0.04		
Loneliness	0.26	0.01	0.23	30.43*	0.19		

PHQ-9, Patient Health Questionnaire-9.

**p* < 0.001.

more general rumination and worry were all related to more loneliness. General rumination and worry achieved a clinically significant effect of medium size (part *r* > 0.30), whereas the effects of the other state variables were negligible.

In the third step, which included coping behaviors, the model explained 32% of the variance in loneliness, adjusted *R*² = 0.32. Doing positive activities at home not done otherwise and experiencing nature were both related to less loneliness. Only doing new activities achieved an effect of small size (part *r* ≥ 0.10).

Loneliness as a Correlate of Depression and Anxiety

Tables 3, 4 present the results of multiple regression analyses using depression and anxiety, respectively, as dependent variables. Loneliness and all variables that were significantly related to loneliness were used as independent variables. Loneliness was related to depression (part *r* = 0.19) and anxiety (part *r* = 0.10).

Sensitivity Analyses

Sensitivity analyses were conducted after selecting a random sample of participants to match the number of males and females as well as the proportion of education levels to correctly reflect the Norwegian adult population. These analyses, which involved 3,098 of the participants, revealed identical results for the group comparisons and the regression analyses in terms of significant findings and level of effect sizes. Thus, the robustness of the presented results was supported.

DISCUSSION

The present study investigated the mental health problem of loneliness in an adult Norwegian community sample (*N* = 10,061) during a period involving the globally in-practice NPIs used to impede transmission of the COVID-19 virus. The aim

TABLE 4 | Results of multiple regression with anxiety (GAD-7) as the dependent variable.

Variables	<i>B</i>	<i>SE</i>	β	<i>t</i>	Part <i>r</i>	<i>R</i> ²	ΔR^2
						0.65	0.65*
Male	−0.44	0.07	−0.04	−7.27*	−0.04		
Age	−0.02	0.00	−0.07	−6.42*	−0.06		
Married or in a civil union	0.24	0.06	0.03	4.12*	−0.02		
Employed	−0.80	0.08	−0.01	−1.03	−0.01		
Psychological diagnosis	1.38	0.08	0.11	16.94*	0.10		
Worry about job and economy	0.17	0.02	0.06	9.70*	0.06		
Health anxiety	0.42	0.01	0.21	31.93*	0.19		
General rumination and worry	1.17	0.02	0.52	66.68*	0.40		
Doing new things at home	−0.08	0.03	−0.02	−2.42*	−0.01		
Experience nature	0.13	0.03	0.03	4.31*	0.03		
Loneliness	0.12	0.01	0.12	17.23*	0.10		

GAD-7, Generalized Anxiety Disorder-7.

**p* < 0.001.

was to investigate (a) the potential risk and resilience factors for loneliness in the Norwegian population during the strict social distancing NPIs and (b) the associations between loneliness and psychopathology symptoms.

The results showed that nearly 80% had stayed home most of the time, indicating that the government-initiated social distancing measures had been adhered to. Thus, a large proportion of individuals had abstained from their usual social life, with some examples including informal contact with colleagues at work, general interaction with peers outside one's household, visits of grandchildren to grandparents, organized sport activities for young adults and physical gatherings with friends and family. Although digital and phone communication could have replaced some of the physical interactions, the extensive restrictions on social interaction are likely to have been accompanied by increased loneliness.

Comparisons across demographic groups led to the identification of the following subgroups with increased loneliness: females, people who do not identify with their own biological sex, young and young to middle-aged people, those with a lower educational level, singles, unemployed, those who do not have children and those who have a psychiatric diagnosis.

In regression analyses, the possible correlations between the independent variables are accounted for, and only the unique contribution of each of these variables to the dependent variable is assessed. Thus, the results may differ somewhat from the group comparisons presented above. Among the stable factors and as hypothesized, being younger, single, less educated, unemployed and having a psychiatric diagnosis were all related to increased levels of loneliness. Exploratively, being male was associated with less loneliness, whereas not having a child and being a refugee were unrelated to loneliness. Part correlations indicated that being single and having a diagnosis achieved small effect sizes. The size of the other relationships was negligible.

More loneliness among younger people was also found in a longitudinal study of adults in the United States before and

during the pandemic (45) and in a longitudinal study of adults in the United Kingdom during the pandemic (46). Young people probably need more social contact and thus may suffer more during the increased isolation. As with the other findings of this study, we do not know whether the younger adults had increased loneliness also before the pandemic.

Among single individuals, comparison processes may strengthen feelings of loneliness, in addition to the direct effect of social distancing. These individuals may withdraw to aloneness and may feel lonelier when comparing their situation with the situations of those who withdraw to their core family.

Having a psychiatric diagnosis is known to be associated with loneliness, as loneliness may be both a cause and an effect of mental disorders, and loneliness and mental disorders may be common effects of life events (11). Moreover, having a diagnosis may lead people to feel different and isolated (47).

Among the state risk factors and as hypothesized, more rumination and worry in general was associated with stronger loneliness, showing a notable medium effect size. This result is consistent with the proposal that rumination and worry may lead to loneliness. The mechanisms tend to be a strain in close relationships, promote an inward focus leading to less engagement in other people and outward tasks, and encourage behavioral inactivity that hinders access to corrective experiences (21–23). Future studies should assess whether rumination and worry create loneliness, whether loneliness creates rumination and worry, or whether the relationship is reciprocal.

As hypothesized, more worry about job and economy was associated with more loneliness, showing a small effect size. The work-related and economic consequences of the pandemic and the implemented NPIs involve a lot of job and financial insecurity, especially for people on low incomes. Thus, as many as 58.8% of the sample worried about their economy for at least some of the days during the last 2 weeks. The results of this study suggest that worry about job and economy has some influence on loneliness. More health anxiety was also related to more loneliness, but the size of this relationship was negligible.

Among the two coping behaviors hypothesized to be associated with loneliness, doing new things at home not done otherwise was negatively related to loneliness with a small effect size. Experiencing nature was also negatively related to loneliness, but the size of this relationship was negligible.

Symptoms of depression and anxiety were prevalent in the present sample. As reported elsewhere (30), 30.8% met the diagnostic cut-off for depression and 25.6% met the cut-off for GAD. Loneliness predicted both depressive and anxiety symptoms with small effect sizes when all potential confounders and psychiatric diagnosis were controlled for. The relationship was more marked for depression, suggesting that loneliness is more closely related to depression than anxiety. Thus, loneliness may be a potential risk factor for depression, and both loneliness and depression may involve internal feedback processes leading to persistence (11) even after the pandemic is controlled and the NPIs lifted.

The strengths of this study are that it captured the effects of NPIs momentarily as they happened and were held constant during the measurement period. Thus, this study provides the

grounds for evaluation and modification of these strategies in real time, as they are still in practice worldwide. A limitation of this study is that random sampling was not conducted because of the urgency of the data collection. Thus, those who chose to respond may have specific features that may affect the results. However, effort was taken to give the adult population an equal opportunity to participate, and the resulting sample turned out to be relatively representative of the adult Norwegian population in terms of the proportion of sub-groups. Moreover, the large sample size allowed us to control for biases in gender and education level through *post-hoc* stratification and sensitivity analyses. These analyses yielded almost identical results to the main analyses, which supports the robustness of the presented results. A further limitation is the cross-sectional design, which impairs the ability to draw conclusions about temporal precedence and causal direction. From our data, it is also impossible to know to the extent to which the obtained relationships were present before the COVID-19 and to what extent they were accentuated during the pandemic. Owing to the lack of ULS-8 data for the Norwegian population in non-pandemic circumstances, we could not provide evidence that the level of loneliness reflected a pandemic increase. Additional limitations are that the variables were assessed by self-report, that the measures of health anxiety and worry about job and economy were self-constructed and are unvalidated, and that rumination and worry were measured by only one item, making this variable prone to measurement error.

Although the causal status of the identified correlates of loneliness is uncertain, two of the obtained part correlations had a clinically relevant size (≥ 0.20) and tentatively suggest some targets of intervention. For people with a psychological diagnosis who attend mental health services, the disruption of these services caused by the implementation of NPIs is likely to increase social isolation and loneliness. As a substitute, remotely delivered methods should be used to provide connectivity and support to patients. Given the potential influence of rumination and worry and the existence of evidence-based psychological therapies for these processes (48) psychological first-aid self-help programs and low-threshold internet-based therapies should be established.

In conclusion, the present survey suggests that people adhere to government-initiated social distancing NPIs during pandemics and withdraw to their homes. It is therefore likely that loneliness increases, although this could not be demonstrated in this study due to a lack of adequate comparison data. Given the strongly increased morbidity and mortality associated with social isolation and loneliness (8, 49), this is a serious downside of the NPIs. The results of the survey further suggests that single individuals and those with a psychiatric diagnosis are especially vulnerable, that loneliness is closely associated with rumination and worry, that doing new positive things at home may mitigate loneliness and that loneliness is associated with depression and anxiety. Longitudinal studies extending through and beyond pandemics are necessary to examine the extent to which increased loneliness persists after the social distancing measures are lifted, whether loneliness leads to symptoms or *vice versa* and the possible mediating relationships between rumination and worry, loneliness and symptoms.

DATA AVAILABILITY STATEMENT

The present dataset includes information about specific behaviors, trait variables, and health outcomes of a large and representative sample of the Norwegian population. In accordance with the guidelines of The Norwegian Centre for Research Data (NSD) and The Regional Committee for Medical and Health Research Ethics (REK), access to the data may be provided to qualified investigators whose proposed use of the data have been approved by all relevant independent review committees in Norway, including REK and NSD, and whose research plans provide a defensible proposal and methodologically sound design with the aims approved by REK, NSD, the university ethics board, and other necessary organizations that require an application process for providing access to sensitive data containing predictive information on a large and representative sample of the Norwegian population. Requests to access the datasets should be directed to Sverre Urnes Johnson, s.u.johnson@psykologi.uio.no.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The Regional Committee for Medical and Mental Health Research Ethics, Gullhaugveien 1-3, 0484 Oslo, Norway. The patients/participants

provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AH analyzed the data, wrote the first draft of the paper, and revised it based on the SJ's and OE's comments. OE administered the collection of the data and conducted data curation. All authors contributed to the conceptualization and methodology of the study.

ACKNOWLEDGMENTS

The present research would not be possible without the immense efforts of multiple individuals and organizations behind its logistics. We are grateful to the team behind the Services for Sensitive Data at the University of Oslo, creating a secure platform for safely and accurately identifying individuals online, as well as safely storing the information obtained from the population. We also owe our gratitude to The Regional Committee for Medical and Health Research Ethics and the Norwegian Centre for Research Data for processing and approving the study protocol and analysis plan in a swift manner given the gravity of the current situation and urgency of the project's research questions. We express our gratitude to the respondents. A preprint of the present paper is published at <https://www.psyrxiv.com/j9e4q> (50).

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Effect of Psychological–Behavioral Intervention on the Depression and Anxiety of COVID-19 Patients

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OPEN ACCESS

Edited by:

Andreas Maercker,
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Reviewed by:

Suqin Tang,
Shenzhen University, China
Andrea B. Horn,
University of Zurich, Switzerland

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 03 August 2020

Accepted: 19 October 2020

Published: 20 November 2020

Citation:

Kong X, Kong F, Zheng K, Tang M,
Chen Y, Zhou J, Li Y, Diao L, Wu S,
Jiao P, Su T and Dong Y (2020) Effect
of Psychological–Behavioral
Intervention on the Depression and
Anxiety of COVID-19 Patients.
Front. Psychiatry 11:586355.
doi: 10.3389/fpsy.2020.586355

The COVID-19 epidemic has caused increasing public panic and mental health stress. In this study, we explore the prevalence and factors linked to anxiety and depression in hospitalized patients with COVID-19. A total of 144 patients diagnosed with COVID-19 underwent depression and anxiety assessment by using the Hospital Anxiety and Depression Scale (HADS). Social support level was also evaluated by the Perceived Social Support Scale (PSSS) at admission. Results showed that gender, age, oxygen saturation, and social support were associated with anxiety for COVID-19 patients. In addition, age, family infection with SARS-CoV-2, and social support were the risk factors associated with depression. Moreover, we designed a psychological–behavioral intervention (PBI) program that included psychological support and breathing exercises, and explored its effects on patients with COVID-19. Of the 144 participants, 26 patients with both anxiety and depression symptoms (cutoff score of ≥ 8 on HADS-A and HADS-D) were randomly assigned to the intervention group and the control group at a 1:1 ratio. After 10-day treatment, the HADS scores of depression and anxiety were significantly reduced in the intervention group, and PSSS scores were also significantly improved. However, no significant differences in HADS and PSSS scores between pre- and post-treatment were found in the control group. Our findings indicate that mental concern and appropriate intervention are essential parts of clinical care for COVID-19 patients.

Keywords: COVID-19, depression, anxiety, social support, psychological-behavioral intervention

INTRODUCTION

Since December, 2019, an outbreak of coronavirus disease 2019 (COVID-19), caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has widely and rapidly spread in China and around the world (1). As of June 21, 2020, more than 8,700,000 confirmed cases and at least 460,000 deaths have been reported in 216 countries (territories/areas), according to the World Health Organization (WHO) (2). The grim epidemic has caused increasing public panic and mental health stress. Mental health is becoming an issue that cannot be ignored, while trying to control the outbreak.

Previous studies have shown that depression and anxiety are common and persistent mental illness in various illnesses including chronic diseases (3, 4) and cancer (5). These studies indicated

that patients with mental illness, including depression and anxiety, may have difficulty with symptom control, as well as impaired quality of life. However, recently published researches on psychological impact of COVID-19 are mainly focused on healthcare workers (6, 7) and the general public (8), who were worried about the risks of infection and protective measures. Note that patients after diagnosis of COVID-19 were more likely to have psychological concerns such as fear of progression of their illness, disability, or premature death. Additionally, it has been reported that psychological distress may affect patient compliance with medical treatment (9, 10) and disease duration (4, 11). Therefore, it is vital to pay attention to the mental health of COVID-19 patients, and appropriate intervention may be beneficial for them. However, so far, the prevalence and related factors of anxiety and depression in patients infected with COVID-19 has been rarely reported.

It has been demonstrated that a psychological intervention can reduce emotional distress, promote positive health habits, and enhance immune responses for patients with cancer and other diseases (12–14). As for infectious diseases, optimism and related constructs could improve the anxiety control and life quality of chronic hepatic B patients (15), as well as the pain management in people with HIV (16). We thought that psychological intervention may be beneficial for patients' mental health and therapeutic process. Given that the doctors involved in the fight against the COVID-19 were not professional psychologists, we mainly referred to U.S. SPIKES (17) and Australian Consensus Guidelines (18) on the strategies for dealing with patients' negative emotions, making the intervention protocol operable for clinical staff. Meanwhile, breathing exercises have been reported to reduce the levels of anxiety and depression and improve pulmonary function (19, 20). Hence, we designed a psychological-behavioral intervention (PBI) program that included psychological support and breathing exercises for patients with anxiety and depression. We intend to investigate whether this kind of intervention could effectively lower anxiety and depression level of patients.

From the above, two aims were included in the present study. Aim 1: To explore the prevalence and factors linked to anxiety and depression in hospitalized patients with COVID-19. Aim 2: To determine the effect of PBI on anxiety and depression of patients with COVID-19.

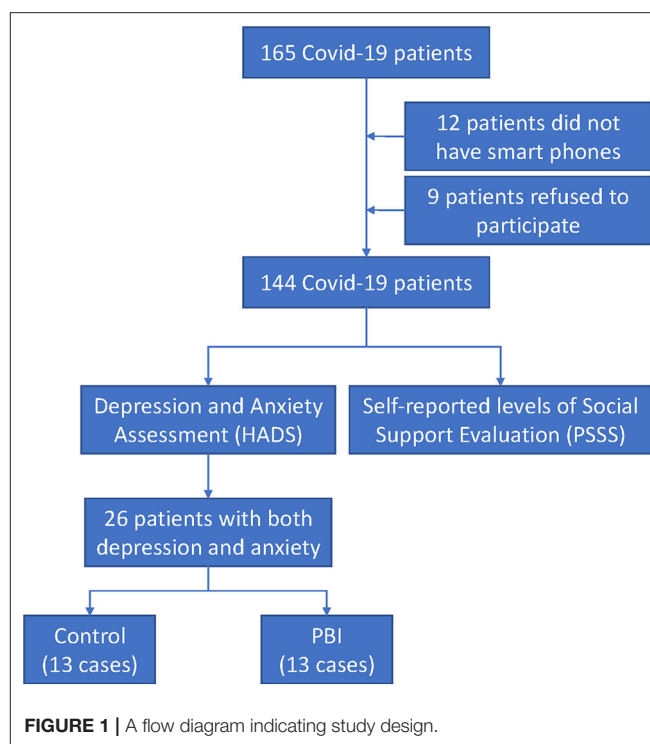
This study may draw more attention to the psychological state of patients with COVID-19 and assist doctors to provide more appropriate treatment and psychological interventions to improve mental and physical health of patients during the campaign to contain and eradicate COVID-19.

METHODS

Prevalence and Factors Linked to Anxiety and Depression in Hospitalized Patients With COVID-19

Participants

Patients were admitted to two divisions (Division 1 of the Second Department and Division 2 of the Fourth Department)



of Huoshenshan Hospital (Wuhan, China) from 23 February 2020 to 13 March 2020. The inclusion criteria were as follows: (1) aged 15–85 years; (2) patients were diagnosed with COVID-19 according to WHO interim guidance. The exclusion criteria were as follows: (1) patients with intellectual and cognitive impairment; (2) patients did not have a smartphone. Informed consent was provided by subjects before study commencement.

The flow diagram (Figure 1) shows that a total of 165 patients were admitted to two divisions of Huoshenshan Hospital during that period. Nine patients refused to participate in the research study, and 12 patients were subsequently excluded due to not having smartphones. Eventually, 144 patients with confirmed COVID-19 completed the questionnaires through an online survey platform ("SurveyStar," Changsha Ranxing Science and Technology, Shanghai, China) at admission. The study was approved by the Research Ethics Commission of Huoshenshan Hospital.

Assessments

Hospital Anxiety and Depression Scale (HADS)

The HADS is a self-assessment questionnaire designed by Zigmond et al. in 1983, which aims to detect anxiety and depression symptoms in general hospital patients. It has been acknowledged that the Chinese version (published in 1993) of the HADS had good internal consistency and favorable scale equivalence (21). The degree of anxiety and depression is rated by the accumulated scores: score 0–7, indicating no anxiety or depression; score 8–10, indicating mild levels of anxiety or depression; score 11–14, indicating moderate levels of anxiety or

depression; and score 15–21, indicating severe levels of anxiety or depression.

Perceived Social Support Scale

The 12-item PSSS was compiled by Zimet et al. in 1987. The Chinese version PSSS (published in 1996) has been widely adopted to measures with perceived support from family, friends, and other ways in the Chinese population (22). Total scores range from 0 to 84, classified into low (12–36), moderate (37–60), and high levels of social support (61–84).

Effect of PBI on Patients With COVID-19 Study Design

This study is a single-center, evaluator-blinded, randomized controlled trial.

Participants

Because all 144 participants completed the HADS questionnaires through an online survey platform “SurveyStar” at admission. We could obtain the scores of each patient once they finished the test. We consecutively recruited the patients with both symptoms of anxiety and depression in the PBI study. A cutoff score of ≥ 8 on both anxiety and depression subscales was applied to identify patients with both anxiety and depression.

Of the 144 participants, twenty-six patients with COVID-19 were identified with both symptoms of anxiety and depression via HADS questionnaire.

Randomization

Twenty-six eligible patients were consecutively and randomly assigned to the PBI group and the control group (13 patients in each group), according to the order of admission. All of them signed the informed consents. There was no difference in the age and sex distribution between the control group and the intervention group. Each patient was isolated in a separate room at the Huoshenshan Hospital. The intervention group and the control group have no chance to communicate with each other about the treatment.

Intervention

All patients were given their normal medical regimens and basic care during hospitalization. For the control group, they communicated with the doctors only on daily ward rounds. While for the intervention group, a 10-day PBI program was carried out when stable status of patients was confirmed after admission.

The details of PBI were as follows:

1. Breathing exercise:

Every morning, two trained medical workers would guide patients to have a breathing exercise for 20 min around 10:00 a. m. (**Supplementary Figure 1**). The breathing exercise is based on Yoga’s breathing techniques and focuses on stimulating nasal and diaphragmatic breathing, increasing the expiratory time, slowing the respiratory flow, and regulating the breathing rhythm.

2. Psychosocial support:

In the present study, we mainly referred to U.S. SPIKES (17) and Australian Consensus Guidelines (18) on the psychosocial support protocols for delivering bad news to patients. We consulted with psychologists to develop the procedure for psychological intervention. Meanwhile, five psychological experts were invited to provide scientific suggestions and feasibility assessment for the psychological intervention.

The psychological intervention process includes:

1. Setting up interview
2. Encouraging patients to express feelings
3. Expressing understanding and comfort patients
4. Giving knowledge and information about COVID-19
5. Providing some simple relaxation techniques, and offering the self-emotional management skills (such as listening to music as a way of distraction when in a bad mood)
6. Summary (helping patients to eliminate mental tension and build up confidence to overcome disease, as well as persuading them to cooperate with treatment and care in a positive and optimistic manner)

The psychological support intervention was designed to be brief within 15 min, considering the limited condition (medical workers needed to wear masks and protective clothing in isolation wards) in communication with patients.

The psychological intervention was performed by two appointed medical staffs, who have been trained for providing the psychological support.

1. Regular training: Before being temporarily assigned to Huoshenshan Hospital, the two appointed medical staffs were medical workers of Changhai Hospital affiliated to Navy Medical University. They have received regular doctor–patient communication training, including lectures on “Common psychological problems with patients” and “How to better communicate with patients” by psychologists at the Naval Medical University.
2. Guidance by Psychological Intervention Manual: After the outbreak of COVID-19, professors from the College of Psychology of the Naval Medical University compiled the “COVID-19 Psychological Guidance Manual.” This manual introduced potential psychological response of patients during the epidemic, and some techniques of psychological care. The two appointed medical staffs studied the manual and held telephone sessions with psychologists, who gave more details about psychological support skills.

The procedure of the psychological intervention was jointly designed by researchers (including the two appointed medical staffs) and psychological experts, according to actual situation of Huoshenshan Hospital. When problems appeared in the implementation process, remote assistance would be given by psychological experts via video calls.

Assessments

Hospital Anxiety and Depression Scale (HADS)

After a 10-day treatment, anxiety and depression of patients were assessed again by use of HADS. The HADS-A (Hospital Anxiety and Depression Scale-Anxiety) score and HADS-D (Hospital

Anxiety and Depression Scale-Depression) scores were used as indexes to evaluate the intervention effects.

Perceived Social Support Scale

After a 10-day treatment, self-reported levels of social support were assessed again by use of PSSS.

Statistical Analysis

SPSS software, version 19 were used for statistical analysis. Means and proportions of the given data for each variable were calculated. Categorical variables were analyzed using the Pearson's chi-square test or Fisher's exact test. Continuous variables were analyzed using non-paired Student *t*-test or paired Student *t* test. Multivariate regression analysis with stepwise method was performed to identify factors associated with depression and anxiety. Multivariate analysis of variance was used to analyze the difference between the PBI group and the control group in the post-treatment HADS score. Differences between groups were considered to be significant when the *p*-value was < 0.05 .

RESULTS

Prevalence and Factors Linked to Anxiety and Depression in Hospitalized Patients With COVID-19

Demographic Characteristics

A total of 165 patients were admitted to two divisions of Huoshenshan Hospital (Wuhan, China) from 23 February 2020 to 13 March 2020. The flow diagram (Figure 1) shows that nine patients refused to participate in the research study and 12 patients were subsequently excluded due to not having smartphones. A total of 144 participants, including 70 male and 74 female, were eligible and completed the questionnaires in the current study. The age of the study participants ranged from 15 to 87 years. Their average age was 49.98 ± 13.73 years. Participants were mostly living with a spouse (121/144, 84%). About a third of the subjects (54/144, 37.5%) were well educated ($\geq$ bachelor's degree), and only 4 of 144 participants (2.8%) had primary education. Oxygen saturation is a key clinical index for evaluating the severity of patients with COVID-19 (23). In the present study, 11.1% of participants who had an oxygen saturation $\leq 93\%$ at rest were with severe disease. Other clinical symptoms of COVID-19 patients were also recorded. As other COVID-19-related studies reported (1, 24–26), fever (84%), cough (78.5%), and shortness of breath (50.7%) were the most common symptoms. In addition, considering that other family members' infection may cause emotional distress to the participants, we also collected the infection status of family members. Fifty-nine participants (41%) had one or more family members infected. Demographic characteristics are listed in Table 1.

Psychosocial Characteristics of the Participants With COVID-19

The mean score of anxiety subscale and depression subscale for all patients was 6.35 ± 4.29 and 5.44 ± 4.32 , respectively. With the reference to HADS, 50 (34.72%) and 31 (28.47%) participants

TABLE 1 | Baseline demographic and clinical characteristic of patients with COVID-19.

	<i>n</i>	%
Gender		
Male	70	48.6
Female	74	51.4
Age (years)		
≤ 50	70	48.6
> 50	74	51.4
Marital status		
Married	121	84.0
Single	17	11.8
Divorced	2	1.4
Widowed	4	2.8
Education status		
Primary	4	2.8
Lower secondary	34	23.6
Upper secondary	52	36.1
University/master/doctorate	54	37.5
Oxygen saturation at rest		
$\leq 93\%$	16	11.1
$> 93\%$	128	88.9
Infection status of family members		
Infected	59	41.0
Non-infected	85	59.0
Clinical symptoms		
Fever	121	84.0
Cough	113	78.5
Shortness of breath	73	50.7
Fatigue	63	43.8
Chest distress	28	19.4
Myalgia	14	9.7

presented symptoms of anxiety and depression, respectively. Regarding the patients' anxiety levels, it was found that 17.36, 12.5, and 4.86% appeared to have mild, moderate, and severe anxiety, respectively. As for the depression levels of patients, 20 were mildly depressed (13.89%), 15 were moderately depressed (10.42%), and 6 were severely depressed (4.17%).

Correlations Among Depression, Anxiety, and Social Support in COVID-19 Patients

There is a large body of evidence that shows that social support plays a beneficial role in mental health (27). Self-reported levels of social support were assessed among the patients with COVID-19. The mean social support score for all participants was 63.41 ± 11.99 . The average score of family, friends, and other support was 22.35 ± 4.42 , 20.53 ± 4.60 , and 20.52 ± 4.55 , respectively. More than half of the participants (90/144, 62.5%) exhibited high level of perceived social support.

The bivariate correlations showed that less social support was correlated with more anxious ($r = -0.196$, $p < 0.05$) and depressive ($r = -0.360$, $p < 0.05$) symptoms (Table 2).

TABLE 2 | Association between anxiety, depression, and social support.

Anxiety	Depression	Social support	Family support	Friend support	Other supports
Anxiety	0.512**	−0.196*	−0.124	−0.165*	−0.230**
Depression		−0.360**	−0.283**	−0.307**	−0.363**
Social support			0.881**	0.875**	0.896**
Family support				0.642**	0.702**
Friend support					0.671**
Other supports					

* $p < 0.05$, ** $p < 0.01$.

In detail, friend support ($r = -0.165$, $p < 0.05$) and other support ($r = -0.230$, $p < 0.05$) were significantly negatively correlated with anxiety. In addition, family support ($r = -0.283$, $p < 0.05$), friend support ($r = -0.307$, $p < 0.05$), and other support ($r = -0.363$, $p < 0.05$) were significantly negatively correlated with depression.

Factors Associated With Depression and Anxiety Among Patients With COVID-19

In order to investigate the factors related to depression and anxiety among patients with COVID-19, anxiety and depression scores were compared between different groups. As shown in **Table 3**, anxiety and depression scores were significantly higher in those who were older (age > 50) and with low education. Additionally, patients with lower oxygen saturation had higher anxiety score, and those getting less social support had higher depression scores.

The multiple linear regression analysis (**Table 4**) showed that gender ($\beta = 1.446$, $p = 0.034$), age ($\beta = 0.074$, $p = 0.003$), oxygen saturation ($\beta = -2.140$, $p = 0.049$), and social support ($\beta = -1.545$, $p = 0.017$) were associated with anxiety for COVID-19 patients. It suggested that female, and patients who are older, with lower oxygen saturation, and less social support would tend to present anxiety symptoms. Moreover, age ($\beta = 0.084$, $p = 0.001$), family infection with SARS-CoV-2 ($\beta = 1.515$, $p = 0.027$), and social support ($\beta = -2.236$, $p < 0.001$) were the factors associated with depression. The results indicate that patients with older age, family member infection, and less social support are more likely to be depressive (**Table 4**).

The Effect of PBI on Patients With COVID-19

The Effect of PBI on Anxiety and Depression of Patients With COVID-19

Of the 144 participants, 26 patients with COVID-19 were identified with both symptoms of anxiety and depression via HADS questionnaire. They were consecutively and randomly assigned to the PBI group and the control group according to the order of admission. **Figure 1** shows that there were 13 patients in each group. There was no significant difference in baseline scores of anxiety and depression between the control group and the PBI group ($p = 0.244$ and $p = 0.431$, respectively) (**Table 5**). The mean score of anxiety and depression for the control group was 11.23 ± 3.219 and 10.77 ± 2.948 . For the PBI group, the

mean score of anxiety and depression was 12.62 ± 2.663 and 11.69 ± 2.926 , respectively.

After a 10-day PBI treatment, the HADS-A score (6.15 ± 3.579) and HADS-D score (5.92 ± 3.730) were significantly reduced in the intervention group ($p < 0.0001$ and $p = 0.0001$, respectively) (**Figures 2A,B** and **Table 6**), whereas the HADS-A score (9.92 ± 3.707) and HADS-D score (9.92 ± 3.707) of the control group were not significantly different after 10-day hospitalization ($p = 0.076$ and $p = 0.098$, respectively) (**Figures 2C,D** and **Table 6**). Additionally, the multivariate analysis of variance showed that there was significant difference between the PBI group and the control group in the post-treatment HADS score ($p = 0.006$, **Table 5**). HADS-A score and HADS-D score were significantly lower in the PBI group than those in the control group after 10-day treatment ($p = 0.014$ and $p = 0.013$, respectively) (**Table 5**).

The number of anxious patients after intervention was three, which was lower ($p = 0.111$) compared with that in the control group ($n = 8$) (**Table 5**). Additionally, there were three depressed patients in the intervention group after PBI, which was less compared with that in the control group ($n = 9$) ($p = 0.047$) (**Table 5**). The above data indicate that PBI is effective in reducing anxiety and depression level in patients with COVID-19.

The Effect of PBI on Social Support Level of Patients With COVID-19

We also investigated the level of social support among 26 patients after 10-day treatment. It was found that the PSSS scores were improved after PBI in the intervention group (pre-treatment = 54.69 ± 15.59 , post-treatment = 64.46 ± 11.05 , $p < 0.0001$), while the PSSS scores in the control group did not alter significantly (pre-treatment = 62.46 ± 9.62 , post-treatment = 65.62 ± 8.13 , $p = 0.241$) (**Figure 3** and **Table 7**). The results imply that the intervention could enhance patients' perceived social support.

DISCUSSION

Prevalence and Factors Linked to Anxiety and Depression in Hospitalized Patients With COVID-19

A number of studies have interlinked depression and anxiety to patients with different diseases (3–5). This study firstly reports the prevalence of anxiety and depression in patients with COVID-19 during the epidemic. The results of the present study

TABLE 3 | Comparison of anxiety and depression scores on different variables ($N = 144$).

	Anxiety score					Depression score				
	Mean $\pm$ SD	<i>t</i>	df	<i>p</i>	Mean difference (95% CI)	Mean $\pm$ SD	<i>t</i>	df	<i>p</i>	Mean difference (95% CI)
Gender										
Male	5.71 $\pm$ 3.98	−1.752	142	0.082	−1.245 (−2.650 to 0.160)	5.47 $\pm$ 4.30	0.073	142	0.942	0.053 (−1.379 to 1.484)
Female	6.96 $\pm$ 4.51					5.42 $\pm$ 4.39				
Age (years)										
≤50	4.91 $\pm$ 3.40	−4.129	142	<0.001	−2.802 (−4.143 to −1.460)	4.33 $\pm$ 4.44	−3.098	142	0.002	−2.171 (−3.557 to −0.786)
>50	7.72 $\pm$ 4.62					6.50 $\pm$ 3.97				
Marital status										
Married	6.53 $\pm$ 4.24	1.122	142	0.264	1.094 (−0.834 to 3.023)	5.50 $\pm$ 4.13	0.326	142	0.745	0.322 (−1.631 to 2.275)
Single/divorced/widowed	5.43 $\pm$ 4.54					5.17 $\pm$ 5.36				
Education level										
Primary/secondary	7.09 $\pm$ 4.66	2.710	142	0.008	1.959 (0.530 to 3.389)	6.06 $\pm$ 4.47	2.217	142	0.028	1.630 (0.176 to 3.083)
University/master/doctorate	5.13 $\pm$ 3.30					4.43 $\pm$ 3.92				
Oxygen saturation at rest										
≤93%	8.75 $\pm$ 5.88	2.407	142	0.017	2.695 (0.482 to 4.909)	6.50 $\pm$ 5.53	1.035	142	0.303	1.188 (−1.081 to 3.456)
>93%	6.05 $\pm$ 3.98					5.31 $\pm$ 4.16				
Infection status of family members										
Infected	6.92 $\pm$ 4.33	1.310	142	0.192	0.951 (−0.484 to 2.385)	6.19 $\pm$ 4.63	1.726	142	0.087	1.257 (−0.183 to 2.697)
Non-infected	5.96 $\pm$ 4.25					4.93 $\pm$ 4.05				
Social support										
High	5.89 $\pm$ 4.28	1.690	142	0.093	−1.241 (−2.692 to 0.211)	4.53 $\pm$ 3.89	3.377	142	0.001	−2.430 (−3.852 to −1.008)
Low–Moderate	7.13 $\pm$ 4.23					6.96 $\pm$ 4.63				

95% CI, 95% confidence interval. The values in bold mean statistically significant.

showed that 34.72 and 28.47% of patients with COVID-19 had symptoms of anxiety or depression, respectively.

In the present study, it is noteworthy that social support is one of the key factors linked to anxiety and depression for patients with COVID-19 (Table 4). The results show that less social support is correlated with more anxious and depressive symptoms (Table 2). Numerous studies have demonstrated that in the case of disease, patients need more social support, including physical and psychological assistance provided by family members, friends, medical workers, and relevant institutions to cope with difficulty (27). There is consistent evidence that shows that social isolation and loneliness are linked to worse mental health outcomes (28). During the COVID-19 epidemic, many isolated patients often felt helpless and lonely due to the lack of family or friends accompanying them. In such circumstances, medical workers as the major peer support are of great significance to infected patients. In clinical practice, Chinese medical members would keep in touch with patients and try various psychological support methods to help isolated patients rebuild confidence. In some Wuhan makeshift hospitals, patients with mild symptoms did Tai Chi practice [which has been verified as an effective way to improve lung function for COPD patients; (29)] and singing and dancing as physical relaxation, accompanied and guided by medical staff. This kind of doctor–patient interaction may encourage patients to maintain a positive mindset.

Meanwhile, older age and lower oxygen saturation are the other factors considered for patients to be anxious. Previous research has revealed that older patients are at increased risk with severe COVID-19 symptoms and death (26). Additionally, oxygen saturation is a key index to evaluate the severity of patients with COVID-19. According to the Chinese management guideline for COVID-19 (30), patients who have an oxygen saturation $\leq 93\%$ at rest are defined as severe-type patients. In this study, 11.1% participants were with low oxygen saturation. These results indicate that patients with severe illness are more likely to be anxious. More psychological care and health attention needs to be given to these critically ill patients.

Consistent with previous report, which focused on the psychological responses among general population during the COVID-19 epidemic in China (8), female patients are also prone to developing higher levels of anxiety as shown in the current study. Meanwhile, education background is another associated factor to the mental distress among infected patients. As we expected, family member infection is another factor affecting patients to be depressed. High levels of concern about other family members and lack of family care may magnify pessimism over the illness.

This study shows that hospitalized patients with COVID-19 experience features of anxiety and depression. The significant factors found in the present study may draw medical workers

TABLE 4 | Multivariate regression analysis of factors associated with anxiety and depression.

	Unstandardized coefficients			Standardized coefficients	<i>t</i>	<i>p</i>
	<i>b</i>	95% CI for <i>b</i>	SE	β		
Anxiety ^a						
Gender (male/female)	1.446	0.111 to 2.780	0.675	0.169	2.142	0.034
Age	0.074	0.025 to 0.123	0.025	0.236	2.987	0.003
Oxygen saturation (≤93%/>93%)	−2.140	−4.268 to −0.012	1.076	−0.157	−1.988	0.049
Social support (low/moderate/high)	−1.545	−2.804 to −0.286	0.637	−0.191	−2.427	0.017
Excluded variables						
Marital status (married/other)	0.029	–	–	–	0.327	0.744
Infection status of family members (yes/no)	−0.128	–	–	–	−1.618	0.108
Education level	0.045	–	–	–	0.547	0.585
Depression ^b						
Age	0.084	0.035 to 0.132	0.024	0.266	3.429	0.001
Infection status of family members (yes/no)	1.515	0.172 to 2.858	0.679	0.173	2.230	0.027
Social support (low/moderate/high)	−2.236	−3.477 to −0.996	0.627	−0.275	−3.564	<0.001
Excluded variables						
Gender (male/female)	0.004	–	–	–	0.052	0.959
Marital status (married/other)	0.141	–	–	–	1.617	0.108
Oxygen saturation (≤93%/>93%)	−0.051	–	–	–	−0.646	0.519
Education level	−0.003	–	–	–	−0.040	0.968

95% CI: 95% confidence interval.

^a Dependent variable: anxiety score.

Predictive variables tested by multiple linear regression (stepwise method): Gender, Age, Oxygen saturation, and Social support.

 $R^2 = 0.153$, $F = 6.274$, $p = 0.000$.^b Dependent variable: depression score.

Predictive variables tested by multiple linear regression (stepwise method): Age, Infection status of family members, and Social support.

 $R^2 = 0.169$, $F = 9.469$, $p = 0.000$.

The values in bold mean statistically significant.

TABLE 5 | Comparison of anxiety and depression level between the PBI group and the control group.

	Number of patients					Score					
	PBI (<i>N</i> = 13)	Control (<i>N</i> = 13)	Chi-square value	df	<i>p</i> ^a	PBI (<i>N</i> = 13)	Control (<i>N</i> = 13)	Mean difference (95%CI)	<i>t</i>	df	<i>p</i> ^b
Pre-treatment											
Anxiety	13	13	–	–	–	12.62 ± 2.663	11.23 ± 3.219	1.385 (–1.006 to 3.776)	1.195	24	0.244
Depression	13	13	–	–	–	11.69 ± 2.926	10.77 ± 2.948	0.923 (–1.455 to 3.301)	0.801	24	0.431
Post-treatment											
Anxiety	3	8	3.939	1	0.111	6.15 ± 3.579	9.92 ± 3.707	-3.769 (–6.719 to -0.820)	-2.637	24	0.014
Depression	3	9	5.571	1	0.047	5.92 ± 3.730	9.38 ± 2.785	-3.462 (–6.126 to -0.797)	-2.681	24	0.013

^a Pearson chi-square test or Fisher's exact test.^b Student *t*-test for independent samples.^c Multivariate analysis of variance (MANOVA), $F = 6.539$, Hypothesis *df* = 2, Error *df* = 23, $p = 0.006$.

PBI, psychological-behavioral intervention.

paying more attention to the mental health of patients with COVID-19.

The Effect of PBI on Patients With COVID-19

Anxiety and depression are related to longer hospitalization (4, 11) and non-adherence to treatment (9, 10) in several diseases. A considerable number of patients with COVID-19 indeed suffered

from depression and anxiety, according to the above results. In this study, we conducted a PBI program to investigate its effect on patients with COVID-19.

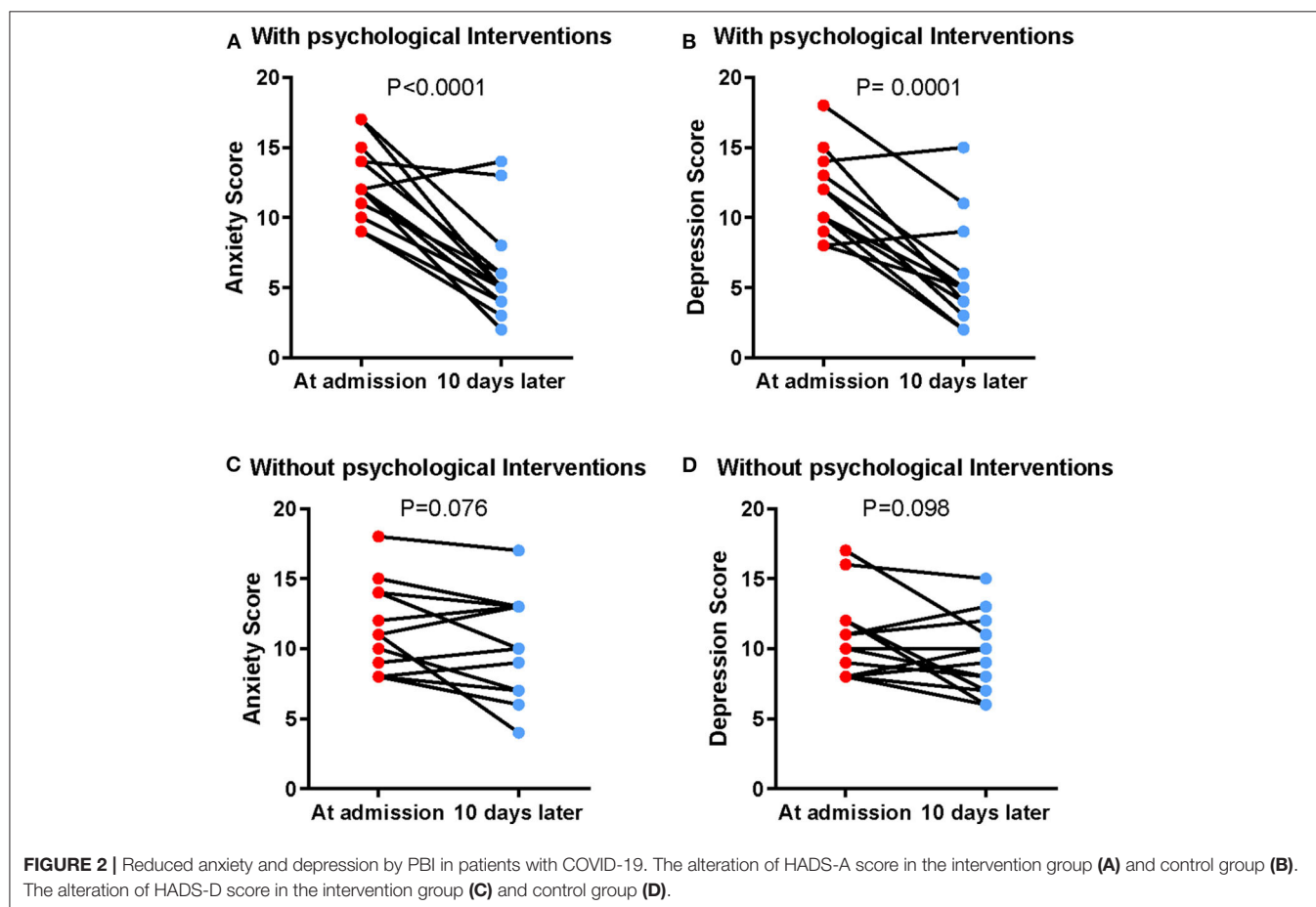
Due to the fact that COVID-19 is a newly emerging pandemic, few studies on psychological intervention for patients have been reported. In order to make the intervention protocol operable for non-psychological clinical staff, we mainly referred to U.S. SPIKES (17) and Australian Consensus Guidelines (18) on

TABLE 6 | Comparison of anxiety and depression scores between pre- and post-treatment in the PBI group and the control group.

		Pre-treatment	Post-treatment	Mean difference (95% CI)	t	df	p ^a
PBI	HADS-A	12.62 ± 2.663	6.15 ± 3.579	6.462 (4.152 to 8.771)	6.097	12	<0.0001
	HADS-D	11.69 ± 2.926	5.92 ± 3.730	5.769 (3.631 to 7.908)	5.877	12	0.0001
Control	HADS-A	11.23 ± 3.219	9.92 ± 3.707	1.308 (−0.160 to 2.775)	1.942	12	0.076
	HADS-D	10.77 ± 2.948	9.38 ± 2.785	1.385 (−0.298 to 3.068)	1.793	12	0.098

^a Paired Student t-test.

HADS-A, Hospital Anxiety and Depression Scale-Anxiety score; HADS-D, Hospital Anxiety and Depression Scale-Depression score.



the psychosocial support protocols for disclosing unfavorable information to patients. It is necessary for medical workers to develop relevant communication skills to reduce patients' negative emotions toward their own diseases in clinical practice (30). Meanwhile, it was found that cough (78.5%) and shortness of breath (50.7%) were two of the most common symptoms of COVID-19 in the current study, consistent with other COVID-19 reports (1, 24–26). Breathing exercises have been proven to improve pulmonary function, as well as reduce the levels of anxiety and depression (19, 20). Therefore, we designed the PBI program with psychological support and breathing exercises.

The results showed that anxiety and depression were relieved in the intervention group compared with the control group

after PBI, which suggested that PBI effectively reduced anxiety and depression in patients with COVID-19. This might be attributable to the fact that patients in the intervention group received frequent communication with medical staff, which resulted in obtaining more information about the disease and their condition, thereby alleviating the anxiety and fear caused by being blind to the disease. In addition, the self-assessment of social support among 26 patients showed that the PSSS scores were significantly improved after PBI in the intervention group, while the PSSS scores in the control group did not change significantly. The psychological counseling and breathing exercises gave more opportunities for patients to contact other people, which reduced the sense of solitude and let them feel support and concern from others, thereby

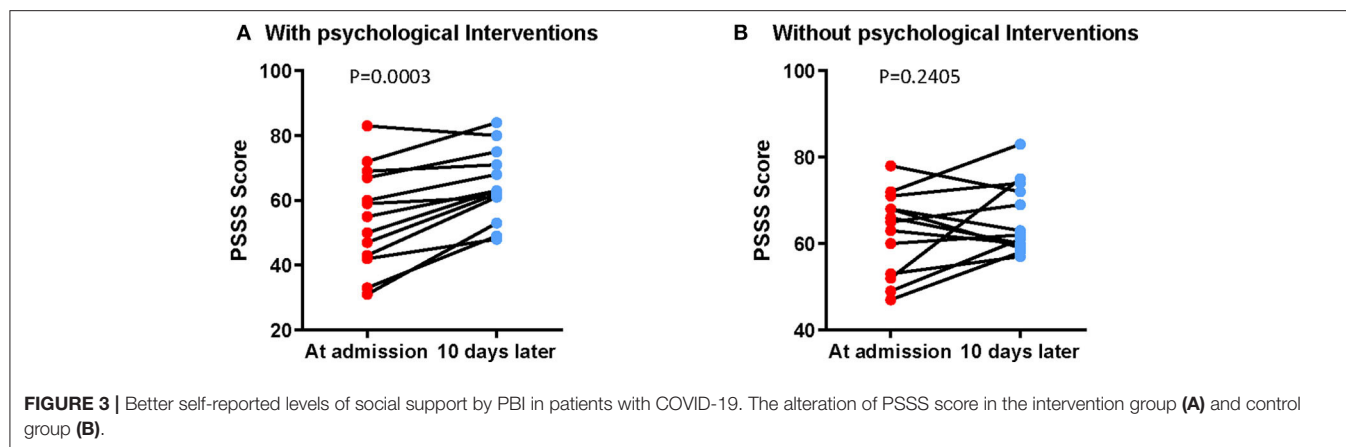


TABLE 7 | Comparison of PSSS scores between pre- and post-treatment in the PBI group and the control group.

	Pre-treatment	Post-treatment	Mean difference (95% CI)	t	df	p ^a
PBI	54.69 ± 15.585	64.46 ± 11.050	−9.769 (−14.065 to −5.474)	−4.955	12	<0.0001
Control	62.46 ± 9.623	65.62 ± 8.130	−3.154 (−8.719 to 2.411)	−1.235	12	0.241

^a Paired Student t-test.

PSSS, Perceived Social Support Scale.

reducing the psychological distress of patients with COVID-19. This is consistent with the discovery that social support is one of the key factors linked to anxiety and depression for patients with COVID-19. Furthermore, we followed up patients in the intervention group using a discharge questionnaire. All of the 13 patients in the intervention group felt that they received social support and social care a lot, and they experienced the warmth of the society while hospitalized (data not shown).

These findings suggest that PBI, as a way of social support, may have a beneficial effect on COVID-19 patients' mental health. We believe that this program can also be applied to other patients with anxiety and depression. In the setting of non-epidemic, this psychological intervention may have a better effect on patients with sufficient time and diverse methods (such as body language, facial expressions, group discussions, lectures, etc.). Early prevention of mental health problems is of vital importance to help patients have good clinical outcomes and better life quality. As the COVID-19 epidemic continues to spread, our findings are particularly instructive to develop a psychological support strategy for hospitalized patients with COVID-19 in China and other areas affected by the epidemic.

STUDY LIMITATION

It is important to take into account several limitations in this study. For instance, the present study was single-centered; the study sample was not representative of all patients with COVID-19 in China, which limited the generalizability of the results. Due to the restriction of the condition, patients' anxiety and

depression assessment was based on a single measurement scale. Additionally, blinding was not feasible for participants and researchers in this study; only the evaluator (who gave the link of questionnaires) and data analyst were blinded for the treatment. Moreover, we found that PBI alleviated anxiety and depression in patients with COVID-19. The PBI program included psychological support and breathing exercises, while the control group only received treatment as usual. Additional evidence is needed to explain whether the effectiveness of PBI is due to the intervention program or more attention offered by medical workers. Lastly, the intervention study has a relatively small number of subjects. A large-scale study is still needed to validate our results.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Research Ethics Commission of Huoshenshan Hospital. Written informed consent to participate in this study was provided by the participants.

AUTHOR CONTRIBUTIONS

YD, XK, and TS conceived and designed the study. YC and YL performed the PBI. PJ, KZ, and MT

collected the clinical data. FK and JZ analyzed the data. JZ, LD, SW, and XK were involved in drafting the manuscript. YD and TS revised the manuscript. All authors contributed to the article and approved the submitted version.

FUNDING

This research was supported by the Military Research Project for COVID-19 Psychological Protection and Intervention Research (GWS20J007).

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ACKNOWLEDGMENTS

We thank all of the patients for their participation in the study.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2020.586355/full#supplementary-material>

Supplementary Figure 1 | Photo of COVID-19 patients hospitalized in Huoshenshan Hospital, who were having breathing exercises guided by trained medical workers.

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Conflict of Interest: JZ, LD, and SW were employed by the company Shanghai Biotecan Pharmaceuticals Co., Ltd.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Anxiety and Sleep Problems of College Students During the Outbreak of COVID-19

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OPEN ACCESS

Edited by:

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 29 July 2020

Accepted: 08 October 2020

Published: 23 November 2020

Citation:

Wang X, Chen H, Liu L, Liu Y,
Zhang N, Sun Z, Lou Q, Ge W, Hu B
and Li M (2020) Anxiety and Sleep
Problems of College Students During
the Outbreak of COVID-19.
Front. Psychiatry 11:588693.
doi: 10.3389/fpsy.2020.588693

This study aimed to explore the psychological situation and the influence of the outbreak of COVID-19 on college students. An online questionnaire survey was conducted among 3,092 Chinese college students who were quarantined at home as a result of the COVID-19 pandemic. The survey tools included the Generalized Anxiety Disorder 7-Item Scale (GAD-7), the Perceived Stress Scale (PSS-10), and the Self-Rating Scale of Sleep (SRSS). Of all the respondents, the prevalence of anxiety symptoms, sleep problems, any of the two, and both of the two, were 16.8, 13.5, 25.1, and 5.3%, respectively. Of the participants, 43.7% of the college students had higher perceived stress. Factors associated with anxiety symptoms included reading the daily news with higher frequency (1–3 times; 4–7 times; more than 7 times), having sleep problems, higher stress, and carelessness with the number of remaining masks. Factors associated with sleep problems included postgraduates, reading the news with higher frequency daily (1–3 times), the frequency of going out per week (1–3 times), having anxiety symptoms and higher stress. Factors associated with higher perceived stress included reading the daily news with higher frequency (4–7 times), anxiety about the number of remaining masks (1–10; more than 20), having anxiety symptoms, and having sleep problems. The prevalence of anxiety symptoms, sleep problems, and higher perceived stress among college students was high during the COVID-19 outbreak. Particular attention should be paid to psychological support for college students quarantined at home, especially those at high risk of psychological problems.

Keywords: COVID-19, college students, psychological health, correlator, psychopathology

INTRODUCTION

Since December 2019, the emergence of COVID-19 has been continuously reported throughout China. Compared to SARS or MERS, COVID-19 is more infectious and spreads faster (1). As of June 3, 2020, more than 84,000 cases had been confirmed in China (2). The cumulative number of diagnoses abroad had exceeded 6 million (2). According to the statistics of the United Nations

Educational, Scientific, and Cultural Organization, the COVID-19 epidemic caused 146 countries to suspend school, and the number of students influenced has reached 1.18 billion (3). Similar to SARS, the COVID-19 outbreak also had a profound impact on people's psychosocial and mental health (4). There have been reports on the psychological status of the general population (5), children (6), medical staff (7), international Chinese students (8), maternal populations (9), and the elderly (10) during the epidemic. In contrast to other populations, college students are more likely to be affected by the COVID-19 epidemic, experiencing uncertainty and abrupt disruption of the semester (11). Meanwhile, college students are one of the special social groups that have attracted much attention. However, there has been little research on the psychological status of college students during the COVID-19 epidemic to date. It was reported that anxiety symptoms and sleep problems might be more prominent in the early stages of the epidemic (12). Thus, the purpose of this study was to assess the prevalence of anxiety and sleep problems and associated factors caused by the COVID-19 pandemic.

METHODS

Study Design

This non-probability sampling survey was conducted among college students in China from February 21 to March 7, 2020. The survey used online questionnaires, which were administered through a web-based survey platform. During the survey, a WeChat QR code with a questionnaire link was sent to WeChat groups at Universities located in 31 provinces and cities across the country. Overseas students were excluded. These questionnaires were completed once per interviewee. The research was approved by the Research Ethics Board at the First Affiliated Hospital of Nanchang University (approval number: 050) and electronic informed consent was obtained from each subject who took part.

Questionnaire

The questionnaire was divided into two parts. The first part collected the basic information of the participants, including the participants' education, gender, and personal protective behaviors during the epidemic. The second part investigated the participants' psychosomatic symptoms during the epidemic, including anxiety, stress, and sleep conditions.

Personal Health Status and Behaviors

This part included personal health status (patients diagnosed with COVID-19/suspected contact/healthy people), the number of times daily they read about the COVID-19 epidemic in the news, the number of times they went out per week, the type of masks they used, the number of remaining masks they had, and the most common network behavior during the epidemic period.

Generalized Anxiety Disorder 7-Item (GAD-7) Scale

The Generalized Anxiety Disorder Scale was compiled by Spitzer (13) and is used for screening generalized anxiety and assessment of symptoms severity. It consists of seven items and is used to understand how long respondents are troubled by seven

problems, including "difficult to relax" and "excessively worried about various problems" in the past 2 weeks. GAD-7 has proven to be a reliable tool for measuring anxiety (14). In this study, cases with anxiety symptoms were defined as a total score of $GAD-7 \geq 5$ (9).

Perceived Stress Scale (PSS-10)

The Perceived Stress Scale was a self-assessment scale compiled by Cohen (15) and is used to assess the degree of stress experienced by an individual in the past month. PSS-10 was used to assess situations that individuals find it difficult to control, difficult to predict, or when they feel overwhelmed. The questionnaire had a total of 10 items, and each item was divided into 0 = never to 4 = very common with a total of 5 grades. Six items in PSS-10 were considered negative (items 1, 2, 3, 6, 9, and 10), which assessed the level of pain. The other four items were positive (items 4, 5, 7, and 8), reflected people's views on the capabilities of stressors. When calculating the total score of PSS-10, the positive entries were reverse coded (15, 16). The higher the score on this scale, the higher the level of perceived stress. In this study, higher perceived stress was defined as a total score of $PSS-10 \geq 14$.

Self-Rating Scale of Sleep (SRSS)

Self-Rating Scale of Sleep is suitable for screening sleep problems in different populations (17). It can also be used to compare the effects of sleep problems before and after treatment (18). This scale has good reliability and validity (19). The higher the score on this scale, the worse the sleep problems. In this study, cases with sleep problems were defined as a total score of $SRSS \geq 23$ (17).

Statistical Analysis

A Chi-square test was used to compare the characteristics of distribution for both anxiety and sleep problems. Binary logistic regression analysis was performed to screen the factors associated with anxiety and sleep problems and calculate the ORs (odds ratios) and a 95% CI (confidence interval). Statistical tests were two-tailed with $p < 0.05$. The database was constructed by EpiData3.1 and analyzed by SPSS 25.0.

RESULTS

Demographic Characteristics of the Respondents

Among all the 3,092 investigated college students, 33.6% were male and 66.4% were female. The respondents were located in 31 provinces and cities across the country, of which 34.8% were from Jiangxi province, located in the southern region of China, 14.5% from Heilongjiang Province, located in the northern region of China, 5.1% from Hubei Province, located in the central region of China and the remaining 45.6% were from other provinces. There were 87.9% undergraduates and 12.1% postgraduates (not including Ph.D. students). The most popular online behavior during the period of the epidemic was playing games, which accounted for 19.6% of the total.

The Prevalence of Anxiety Symptoms, Sleep Problems, and Perceived Higher Stress Among College Students

Among the investigated college students, the prevalence of anxiety symptoms, sleep problems, anxiety symptoms or sleep problems, and anxiety symptoms and sleep problems were 16.8, 13.5, 25.1, and 5.3%, respectively. Overall, 43.7% of college students had higher perceived stress.

The prevalence of anxiety symptoms was significantly higher in college students with the following characteristics: postgraduates (22.4 vs. 16.1%) and those who read the news with higher frequency daily [None (9.8%); 1–3 times (15.1%); 4–7 times (19.0%); more than 7 times (29.6%)]. In terms of wearing a mask, these experienced anxiety when not wearing a mask (22.1%); wearing a disposable medical mask (15.5%); wearing an N95 mask or medical protective mask (14.9%); when wearing other common masks (19.1%), and when they had few remaining masks [0 (22.0%); 1–10 (17.0%); 10–20 (16.6%); had more than 20 masks (15.2%); and those who did not know how many remaining masks they had (9.5%)]. The students also experienced anxiety when they were having sleep problems (39.1 vs. 13.4%) and higher perceived stress (27.3 vs. 8.7%) (Table 1).

The prevalence of sleep problems was significantly higher in college students with the following characteristics: postgraduates (20.0 vs. 12.6%) who read the news with higher frequency daily [None (21.1%); 1–3 times (11.7%); 4–7 times (14.9%); more than 7 times (20.7%)]. Sleep problems were increased among those who had a higher frequency of going out per week [None (12.3%); 1–3 times (14.9%); who went out more than 3 times (20.0%)], who went out wearing a mask [not wearing a mask (18.5%); wearing a disposable medical mask (11.7%); wearing an N95 mask or medical protective mask (15.4%); or who went out wearing other common masks (14.6%)]. Of these, a number had anxiety symptoms (31.3 vs. 9.9%) and higher perceived stress (21.0 vs. 7.6%).

The prevalence of any of the two psychological problems was significantly higher in college students with the following characteristics: postgraduates (33.9 vs. 23.8%) and those who read the news with higher frequency daily [None (25.6%); 1–3 times (22.8%); 4–7 times (27.2%); more than 7 times (37.8%)]. Either of these psychological problems was experienced by those who had a higher frequency of going out per week [None (23.3%); 1–3 times (27.1%); more than 3 times (33.8%)], and those who went out not wearing a mask [not wearing a mask (30.4%); wearing a disposable medical mask (23.4%); N95 mask or medical protective mask (24.9%); or other common masks (27.1%)], and there was a higher perceived level of stress (38.0 vs. 15.0%).

The prevalence of both of the two psychological problems was significantly higher in college students with the following characteristics: postgraduates (8.5 vs. 4.8%) and those who read the news with higher frequency daily [None (5.3%); 1–3 times (4.0%); 4–7 times (6.7%); more than 7 times (12.5%)]. Both problems were experienced by those who went out wearing a mask [not wearing a mask (10.1%); disposable medical mask (3.8%); N95 mask or medical protective mask (5.5%); other common masks (6.7%)], with few remaining masks [0 (9.8%); 1–10 (5.0%); 10–20 (4.1%), more than 20 masks left (4.1%) and

those who did not know the number of remaining masks (3.4%)], and there was higher perceived stress (10.3 vs. 1.4%).

The prevalence of higher perceived stress was significantly greater in college students with the following characteristics: those who read the news with higher frequency daily [None (53.4%); 1–3 times (42.7%); 4–7 times (41.9%); more than 7 times (49.7%)], those who went out not wearing a mask [not wearing a mask (54.0%); disposable medical mask (41.4%); N95 mask or medical protective mask (42.5%); other common masks (45.6%)], and those who had few masks [0 (53.5%); 1–10 (41.3%); 10–20 (46.6%); more than 20 (37.7%); those who did not know how many remaining masks they had (52.0%)], those having anxiety symptoms (70.8 vs. 38.2%), and those having sleep problems (68.1 vs. 39.9%).

Factors Associated With Anxiety Symptoms, Sleep Problems, and Perceived Stress Among College Students

By establishing a logistic regression model, we found that there was a higher frequency of reading the news daily [1–3 times (OR, 2.3, 95%CI: 1.3–4.3); 4–7 times (OR, 3.2, 95%CI: 1.6–6.1); more than 7 times (OR, 5.1, 95%CI: 2.6–9.9)], higher perceived stress (OR, 3.4, 95%CI: 2.8–4.2), and sleep problems (OR, 3.1, 95%CI: 2.4–4.0) were significantly associated with a higher risk of the symptoms of anxiety. Protection factors associated with anxiety symptoms included that they were careless with the number of remaining masks (OR, 0.4, 95%CI: 0.2–0.7) (Table 2).

Postgraduates (OR, 1.6, 95%CI: 1.2–2.1), the frequency of going out per week (1–3 times) (OR, 1.3, 95%CI: 1.1–1.7), higher perceived stress (OR, 2.4, 95%CI: 1.9–3.1) and having anxiety symptoms (OR, 3.1, 95%CI: 2.4–3.9) were significantly associated with a higher risk of sleep problems. The protection factors associated with sleep problems included the frequency of daily news reading (1–3 times) (OR, 0.5, 95%CI: 0.3–0.8).

Having anxiety symptoms (OR, 3.4, 95%CI: 2.8–4.2) and having sleep problems (OR, 2.5, 95%CI: 2.0–3.1) were significantly associated with a higher risk of perceived stress. Protection factors associated with higher perceived stress included a higher frequency of daily news reading (4–7 times) (OR, 0.7, 95%CI: 0.4–0.9) and remaining masks [1–10 (OR, 0.7, 95%CI: 0.5–0.9); more than 20 (OR, 0.6, 95%CI: 0.5–0.8)].

DISCUSSION

In this survey, the prevalence of college students with psychological problems was 25.1%: anxiety symptoms 16.8%, sleep problems 13.5%, both of the two 5.3%. 43.7% of college students had perceived higher stress. In this study, the factors associated with anxiety symptoms included sleep problems, stress levels, the number of remaining masks, and the frequency of daily news reading. Factors associated with sleep problems included stress levels, anxiety symptoms, the frequency of going out per week, and daily news reading. The factors associated with perceived stress included anxiety symptoms, sleep problems, the frequency of daily news reading, and the number of remaining masks. The

TABLE 1 | Prevalence of anxiety symptoms, sleep problems, and perceived stress among college students[†].

Characteristic	Group	N	Anxiety symptoms % (95%CI)	Sleep problems % (95%CI)	Any of the two % (95%CI)	Both of the two % (95%CI)	Perceived stress % (95%CI)
Gender	Male	1,038	16.3 (14.0–18.5)	14.0 (11.9–16.1)	25.0 (22.4–27.7)	5.2 (3.8–6.6)	45.5 (42.4–48.5)
	Female	2,054	17.1 (15.5–18.8)	13.2 (11.8–14.7)	25.1 (23.2–26.9)	5.3 (4.3–6.3)	42.8 (40.7–45.0)
	P		0.548	0.576	0.988	0.902	0.164
Education	Bachelor	2,717	16.1 (14.7–17.5)	12.6 (11.3–13.8)	23.8 (22.2–25.5)	4.8 (4.0–5.6)	43.4 (41.6–45.3)
	Postgraduate	375	22.4 (18.2–26.6)	20.0 (15.9–24.1)	33.9 (29.1–38.7)	8.5 (5.7–11.4)	45.9 (40.8–50.9)
	P		0.002	<0.001	<0.001	0.003	0.373
Frequency of daily news reading	None	133	9.8 (4.7–14.9)	21.1 (14.0–28.1)	25.6 (18.1–33.1)	5.3 (1.4–9.1)	53.4 (44.8–62.0)
	1–3 times	2,192	15.1 (13.6–16.6)	11.7 (10.4–13.1)	22.8 (21.1–24.6)	4.0 (3.2–4.8)	42.7 (40.6–44.8)
	4–7 times	463	19.0 (15.4–22.6)	14.9 (11.6–18.2)	27.2 (23.1–31.3)	6.7 (4.4–9.0)	41.9 (37.4–46.4)
	More than 7 times	304	29.6 (24.4–34.8)	20.7 (16.1–25.3)	37.8 (32.3–43.3)	12.5 (8.8–16.2)	49.7 (44.0–55.3)
	P		<0.001	<0.001	<0.001	<0.001	0.012
Frequency of going out per week	None	1,900	16.1 (14.4–17.7)	12.3 (10.8–13.7)	23.3 (21.4–25.2)	5.0 (4.0–6.0)	43.0 (40.8–45.2)
	1–3 times	1,062	17.5 (15.2–19.8)	14.9 (12.7–17.0)	27.1 (24.4–29.8)	5.3 (3.9–6.6)	44.1 (41.1–47.1)
	More than 3 times	130	23.1 (15.7–30.4)	20.0 (13.0–27.0)	33.8 (25.6–42.1)	9.2 (4.2–14.3)	51.5 (42.8–60.2)
	P		0.091	0.012	0.004	0.113	0.159
Mask type	Not wearing a mask	335	22.1 (17.6–26.6)	18.5 (14.3–22.7)	30.4 (25.5–35.4)	10.1 (6.9–13.4)	54.0 (48.7–59.4)
	Disposable medical mask	1,754	15.5 (13.8–17.2)	11.7 (10.2–13.2)	23.4 (21.4–25.4)	3.8 (2.9–4.7)	41.4 (39.1–43.7)
	N95 mask or medical protective mask	402	14.9 (11.4–18.4)	15.4 (11.9–19.0)	24.9 (20.6–29.1)	5.5 (3.2–7.7)	42.5 (37.7–47.4)
	Other common masks	601	19.1 (16.0–22.3)	14.6 (11.8–17.5)	27.1 (23.6–30.7)	6.7 (4.7–8.7)	45.6 (41.6–49.6)
	P		0.007	0.003	0.027	<0.001	<0.001
Remaining mask	0	441	22.0 (18.1–25.9)	17.2 (13.7–20.8)	29.5 (25.2–33.8)	9.8 (7.0–12.5)	53.5 (48.8–58.2)
	1–10	1,427	17.0 (15.0–18.9)	13.2 (11.5–15.0)	25.2 (23.0–27.5)	5.0 (3.8–6.1)	41.3 (38.8–43.9)
	10–20	440	16.6 (13.1–20.1)	11.6 (8.6–14.6)	24.1 (20.1–28.1)	4.1 (2.2–5.9)	46.6 (41.9–51.3)
	More than 20	605	15.2 (12.3–18.1)	12.2 (9.6–14.8)	23.3 (19.9–26.7)	4.1 (2.5–5.7)	37.7 (33.8–41.6)
	Careless the number of remaining masks	179	9.5 (5.2–13.8)	15.1 (9.8–20.4)	21.2 (15.2–27.3)	3.4 (0.7–6.0)	52.0 (44.6–59.3)
	P		0.002	0.094	0.125	<0.001	<0.001
Network behavior	Others	2,485	16.7 (15.3–18.2)	13.4 (12.1–14.8)	25.1 (23.4–26.8)	5.1 (4.2–6.0)	42.9 (41.0–44.9)
	Online games	607	17.3 (14.3–20.3)	13.7 (10.9–16.4)	25.0 (21.6–28.5)	5.9 (4.0–7.8)	47.0 (43.0–50.9)
	P		0.742	0.880	0.988	0.418	0.074
Stress	Normal	1,740	8.7 (7.4–10.1)	7.6 (6.4–8.9)	15.0 (13.3–16.7)	1.4 (0.8–1.9)	–
	Higher ^a	1,352	27.3 (24.9–29.7)	21.0 (18.8–23.2)	38.0 (35.4–40.6)	10.3 (8.7–11.9)	–
	P		<0.001	<0.001	<0.001	<0.001	–
Anxiety	No ^b	2,571	–	9.9 (8.7–11.0)	–	–	38.2 (36.4–40.1)
	Yes	521	–	31.3 (27.3–35.3)	–	–	70.8 (66.9–74.7)
	P		–	<0.001	–	–	<0.001
Sleep problems	No ^c	2,675	13.4 (12.1–14.7)	–	–	–	39.9 (38.1–41.8)
	Yes	417	39.1 (34.4–43.8)	–	–	–	68.1 (63.6–72.6)
	P		<0.001	–	–	–	<0.001

[†]95% CI, 95% confidence interval.^aHigher stress, defined as a total score of Perceived Stress Scale-10 ≥ 14 .^bNot having anxiety symptoms, defined as a total score of Generalized Anxiety Disorder 7-Item (GAD-7) Scale < 5.^cHaving sleep problems, defined as a total score of Sleep-Rating Scale of Sleep < 23.

prevalence of anxiety symptoms among college students was significantly higher than during the non-epidemic period in China (7.5%) (20).

The prevalence of anxiety symptoms in college students during the COVID-19 epidemic was higher than that reported in the general population (21). This might be because of

TABLE 2 | Factors associated with anxiety symptoms, sleep problems, and perceived stress among college students[†].

Characteristic	Group	Anxiety symptoms OR (95%CI)	Sleep problems OR (95%CI)	Both of the two OR (95%CI)	Perceived stress OR (95%CI)
Gender	Male	1	1	1	1
	Female	1.2 (1.0–1.5)	1.0 (0.8–1.3)	1.3 (0.9–1.9)	0.9 (0.8–1.1)
Education	Bachelor	1	1	1	1
	Postgraduate	1.3 (1.0–1.7)	1.6 (1.2–2.1)**	1.6 (1.1–2.5)*	0.9 (0.7–1.2)
Frequency of daily news reading	None	1	1	1	1
	1–3 times	2.3 (1.3–4.3)**	0.5 (0.3–0.8)**	1.0 (0.5–2.4)	0.7 (0.5–1.0)
	4–7 times	3.2 (1.6–6.1)**	0.6 (0.4–1.1)	2.0 (0.8–4.9)	0.7 (0.4–0.9)*
	More than 7 times	5.1 (2.6–9.9)***	0.8 (0.4–1.3)	3.3 (1.4–7.9)**	0.7 (0.5–1.1)
Frequency of going out per week	None	1	1	1	1
	1–3 times	1.1 (0.9–1.4)	1.3 (1.1–1.7)*	1.3 (0.9–1.8)	1.1 (0.9–1.3)
	More than 3 times	1.3 (0.8–2.1)	1.5 (0.9–2.4)	1.6 (0.8–3.2)	1.3 (0.9–1.9)
Mask type	Not wearing a mask	1	1	1	1
	Disposable medical mask	0.7 (0.5–1.0)	1.2 (0.8–1.7)	0.8 (0.5–1.4)	0.9 (0.7–1.2)
	N95 mask or medical protective mask	0.8 (0.6–1.1)	0.9 (0.6–1.1)	0.6 (0.4–0.9)*	0.9 (0.7–1.1)
	Other common masks	1.1 (0.7–1.7)	1.2 (0.8–1.9)	1.3 (0.7–2.3)	1.1 (0.8–1.5)
Remaining mask	0	1	1	1	1
	1–10	1.0 (0.7–1.4)	1.0 (0.7–1.4)	0.8 (0.5–1.3)	0.7 (0.5–0.9)**
	10–20	0.9 (0.6–1.4)	0.8 (0.5–1.3)	0.6 (0.3–1.2)	0.9 (0.7–1.2)
	More than 20	0.9 (0.6–1.3)	1.0 (0.6–1.5)	0.7 (0.4–1.3)	0.6 (0.5–0.8)**
	Careless the number of remaining masks	0.4 (0.2–0.7)**	1.2 (0.7–2.1)	0.4 (0.2–1.1)	1.2 (0.8–1.7)
Network behavior	Online games	1	1	1	1
	Others	0.9 (0.7–1.2)	1.0 (0.8–1.3)	0.8 (0.6–1.3)	0.9 (0.7–1.1)
Stress	Normal	1	1	1	–
	Higher ^a	3.4 (2.8–4.2)***	2.4 (1.9–3.1)***	7.7 (5.0–12.1)***	–
Anxiety	No ^b	–	1	–	1
	Yes	–	3.1 (2.4–3.9)***	–	3.4 (2.8–4.2)***
Sleep problems	No ^c	1	–	–	1
	Yes	3.1 (2.4–4.0)***	–	–	2.5 (2.0–3.1)***

[†]OR, odds ratio; 95%CI, 95% confidence interval.

^aHigher stress, defined as a total score of Perceived Stress Scale-10 ≥ 14 .

^bNot having anxiety symptoms, defined as a total score of Generalized Anxiety Disorder 7-Item (GAD-7) Scale < 5 .

^cHaving sleep problems, defined as a total score of Sleep-Rating Scale of Sleep < 23 .

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

the suddenness and unpredictability of the epidemic, which affected normal academic planning. However, the prevalence of anxiety symptoms was slightly lower than that reported in another study involving college students (22). This might be explained by the fact that the epidemic gradually came under control, with a decreasing number of newly confirmed COVID-19 cases during the survey. Besides, unlike the previous study, the population of subjects was investigated in this study to include not only medical students but also non-medical students. Compared with medical students, non-medical students might be less prone to psychological problems (23).

Reflecting the findings of a previous study, college students with higher perceived stress had a higher risk of symptoms of anxiety symptoms and sleep problems. When exposed

to chronic stressors in the long-term, people were more likely to have psychological problems such as depression and anxiety (24).

Compared with college students who did not know the number of remaining masks they had, those without any mask had a higher risk of anxiety symptoms. Studies have shown that wearing masks could effectively reduce the risk of contracting the virus (25, 26). Therefore, those without any masks were more prone to anxiety symptoms.

Those who frequently read news about the epidemic had a higher risk of anxiety symptoms. In an “online” society, news spreads faster than before. The long-term impact of receiving constant news about adverse events can have negative psychological effects. Furthermore, the frequency of mobile phone dependence in college students was higher

than before (27). During the early stages of the epidemic, unconfirmed news was reprinted on all kinds of social media. Similar to other findings, college students addicted to online games were more likely to report psychological problems (28). Based on these findings, we suggest that colleges should consider issuing guidance and suggestions to regulate the online behaviors of students through official channels, to reduce the impact of unhealthy internet behaviors on physical and psychological well-being.

Sleep problems among college students was a significant factor that can be used to measure their psychological problems. In this study, the prevalence of sleep problems among participants was slightly higher than before the pandemic (29). This might be because the college students that were surveyed were quarantined at home during the outbreak. This experience was accompanied by uncertainty about the development of the epidemic. Compared with those on bachelor degrees, postgraduate students were more prone to sleep problems. This might be because they faced additional pressure from scientific research. College students with a higher frequency of going out per week had a higher risk of having sleep problems. This could be explained by their fear of being infected or going out frequently. In addition to anxiety and insomnia, college students also faced additional pressure. As discussed above, many colleges and Universities delayed the start of school terms due to the epidemic, which might bring further stress. How to intervene in their psychological conditions during and after the epidemic is also a key issue for colleges and Universities to explore.

CONCLUSIONS

The prevalence of anxiety symptoms and sleep problems were high in the investigated college students. The factors associated with anxiety symptoms and sleep problems varied. Bearing in mind the importance of precision prevention, our findings suggest that targeted psychological intervention for college

students should be integrated into the work plan to fight against the COVID-19 epidemic.

LIMITATIONS

There are three limitations to this study. Firstly, this study, which was carried out during the COVID-19 epidemic, adopted a non-probability sampling survey, not a random sample survey. Secondly, the survey tools in this study could only be used to evaluate psychological health states instead of psychological disorders. Finally, there were many factors associated with anxiety, sleep, and perceived stress in addition to the impact of COVID-19, and caution should be taken when extrapolating the results.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The research was approved by the Research Ethics Board at The First Affiliated Hospital of Nanchang University and electronic informed consent was obtained from each investigated subject (approval number: 050).

AUTHOR CONTRIBUTIONS

XW and LL: formal analysis, investigation, and writing of the original draft. HC: conceptualization, methodology, investigation, reviewing, and editing the manuscript. YL: investigation and writing of the original draft. NZ: formal analysis and investigation. ZS, QL, and WG: investigation. BH and ML: conceptualization, data curation, methodology, investigation, reviewing, editing the manuscript, and supervision. All authors contributed to the article and approved the submitted version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Adverse Mental Health Impact of the COVID-19 Lockdown in Individuals With Tourette Syndrome in Italy: An Online Survey

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OPEN ACCESS

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 15 July 2020

Accepted: 30 October 2020

Published: 30 November 2020

Citation:

Conte G, Baglioni V, Valente F,
Chiarotti F and Cardona F (2020)
Adverse Mental Health Impact of the
COVID-19 Lockdown in Individuals
With Tourette Syndrome in Italy: An
Online Survey.
Front. Psychiatry 11:583744.
doi: 10.3389/fpsy.2020.583744

During the early stages of the coronavirus disease 2019 (COVID-19) pandemic in Italy, an online survey was launched via a local patient advocacy website to investigate mental health issues in children and adolescents with Tourette syndrome (TS). Respondents were parents, who were asked to report on their child's general health, tics, comorbidities/problems, pharmacological treatment/psychotherapy, symptom variations, and daily routine, as well as on their family's health and work experiences during the pandemic. Two hundred thirty-eight people participated in the survey, 203 females and 35 males. Our findings indicate that, in the time window of 4–6 weeks after the beginning of the COVID-19-related lockdown, 67% of individuals with TS developed a relevant worsening of the overall clinical condition as rated by their parents. An improvement or no variation of the clinical picture was reported in 20.5 and 6.7% of cases, respectively. Most worsened symptoms included tics, hyperactivity, rage attacks, obsessions/compulsions, and anxiety. Of the subjects experiencing a clinical worsening, the majority (51.76%) showed variations across two to five symptom domains. No association was found between symptom variation and family demographics or health and economic issues specifically related to the lockdown. The current COVID-19 pandemic is exerting a considerable impact on the mental health of young individuals with TS by worsening both tics and emotional and behavioral symptoms.

Keywords: Tourette syndrome, COVID-19, pandemic, mental health, tics, children, adolescents

INTRODUCTION

At the end of February 2020, the epicenter of the current coronavirus disease 2019 (COVID-19) pandemic shifted from China to Europe, with Italy being the first country to witness a massive peak in infections and fatalities (1, 2). In the past few months, the Italian government has put forward unprecedented measures to contain the outbreak, placing residents in a nationwide lockdown, and banning any movement inside the country. Such measures were ongoing until 4 May (3).

Each pandemic poses particular mental health risks in that it implies not only the spreading of a physical illness but also an overflow of anxiety and mass panic as possible reactions to health concerns. Moreover, common measures implemented by governments to restrain the outbreak, such as social distancing, isolation, and contact tracing policies, may further disrupt the collective

sense of reality and order, worsening the emotional and psychological burden experienced by individuals (4). Previous research dealing with the mental health impact of pandemics has mainly focused on subjects put into isolation or quarantine, demonstrating psychiatric complications, such as anxiety and depression, in up to 40% of cases (5, 6). In the few studies regarding pediatric populations in similar conditions, externalizing and disruptive behaviors have also been frequently reported (7, 8).

Under such circumstances, those with a pre-existing mental health condition and especially children and adolescents with neuropsychiatric disorders appear as a particularly vulnerable population (9).

Tourette syndrome (TS) is a neurodevelopmental chronic condition defined by multiple motor and phonic tics (10). TS is a multifaceted disorder and is highly comorbid with conditions such as obsessive-compulsive disorder (OCD) and anxiety and attention deficit/hyperactivity disorder (ADHD) (11).

Although the underlying pathophysiological mechanisms is still unknown, a distinctive feature of TS is the great temporal variability of symptoms, both of tics and comorbidities (12). In TS patients, symptom expression is also systematically influenced by contextual factors (13) and is generally increased at home than in more social situations (14). Therefore, environmental factors such as the lockdown due to COVID-19 may significantly contribute in TS to concurrent symptom fluctuations, especially through mechanisms of setting modification and habit disruption, as resulting from mass school closures and stay-at-home orders.

In this study, we sought to provide an overview of the emotional and behavioral symptoms expressed by children and adolescents with TS in the early stages of the COVID-19 lockdown in Italy. We were also interested in determining whether symptom variations were associated with any specific sociodemographic variable or with health and economic issues developed during the pandemic within their families.

MATERIALS AND METHODS

Data Source

For data collection, a brief online survey was developed by the Department of Human Neurosciences at Sapienza University of Rome and promoted by “Tourette Roma onlus,” a local patient advocacy association. The survey was launched on the association’s website on 1 April 2020 (i.e., 3 weeks after the beginning of the general lockdown in Italy) and online records were collected until 14 April 2020). The study was conformed to the Declaration of Helsinki, and each submitted record was completely anonymous, therefore exempting the study from institutional Ethics Committee examination. The survey was directed to parents of individuals with TS and included different sections, with a total of 26 multiple-choice questions. Originally, the online form was developed for the parents of children and adolescents; however, a certain number of parents of adult patients also participated. Therefore, we decided to include the latter data in our analysis to offer a wider point of view on the investigated topic.

Participants were asked to report on their child’s general health, tics, comorbidities/problems, variations of symptoms during the lockdown, presence and eventual changes in the pharmacological treatment/psychotherapy. Moreover, a survey section was dedicated to family demographics and impact of the pandemic on the child’s daily activities as well as on family health and work experiences.

Data Analysis

Data are presented as absolute and percent frequencies. Percent frequencies were calculated on the number of respondents to each item. The chi-square test was used to assess the effect of both participants’ and offspring’s variables on the variation of TS symptoms and quality of parent-child relationship. Participants’ variables were as follows: age, gender, education, occupation, presence of domestic help before the pandemic (i.e., babysitter, grandparents/relatives looking after the child), geographical area of residence, living with partner, number of offspring and of family members, medical problems related to COVID-19, and economic changes related to the pandemic. Offspring’s variables included the following: age, gender, comorbidities, pharmacological therapy and need of eventual adjustment during the lockdown phase, psychotherapy and its eventual variation due to lockdown, and time spent in school and other activities during the lockdown.

Because of the exploratory design of the study, we present the values of significance without correcting for multiple testing.

RESULTS

Participants

Two hundred thirty-eight people participated in the survey. Of them, 203 (85.29%) were females and 35 (14.71%) males. The general rate of responses was 81%.

Table 1 displays geographic distribution, age, education level, employment status and family demographics of the participants. Participants living in Regions with medium rates of COVID-19 infections (i.e., number of confirmed cases/resident population, following the official data of the Italian Minister of Health updated as of 14 April 2020) were the most prevalent (46.64%), although highly impacted Regions were also largely represented (39.92%).

Impact of the COVID-19 Epidemic on Family Health and Parents’ Employment and Economic Status

About a quarter of the participants ($n = 60$ out of 230 who answered this question; 26.09%) have reported COVID-related health issues, such as hospitalization, illness or death among family members/friends, quarantine after contact with a confirmed case, or need for swabbing. Remarkably, about 32% of participants or their partners experienced a considerable reduction of the income due to unexpected lay-off or job uncertainties as a result of the pandemic, with 17% facing such consequence both themselves and their partners.

TABLE 1 | Socio-demographic characteristics of participants.

	<i>n</i>	%
Geographic distribution		
Regions with high number of confirmed cases* (Lombardy, Veneto, Emilia—Romagna, Piedmont, Trentino, Liguria, and Marche)	95	39.92
Regions with medium number of confirmed cases* (Lazio, Tuscany, Campania, Abruzzo, Apulia, Friuli VG, Valle d'Aosta, Molise, and Umbria)	111	46.64
Regions with low number of confirmed cases* (Calabria, Sicily, Sardinia, and Basilicata)	32	13.44
Age		
20–30 years	5	2.10
31–40 years	49	20.59
41–50 years	120	50.42
51–60 years	53	22.27
>61 years	11	4.62
Education level		
Primary	5	2.10
Lower secondary	36	15.13
Upper secondary	120	50.42
Bachelor or equivalent level	77	32.35
Employment status		
Not employed	17	7.14
Employee	124	52.10
Self-employed or freelancer	36	15.13
Homemaker	51	21.43
Retired	10	4.20
Number of offspring		
1	54	23.11
2	144	60.50
3	36	15.13
>3	3	1.26
Number of people living at home (including relatives)		
2	11	4.62
3	62	26.05
4	133	55.88
5	28	11.76
>5	4	1.68

*Number of cases/resident population following the official data of the Italian Minister of Health.

Participants' Offspring With Tourette Syndrome

We gathered data on 223 participant's offspring with Tourette Syndrome.

Number of males was 188 (84.30%) and females 35 (15.70%), male-to-female ratio of 5.4–1.

Eighty-four subjects (37.67%) were in the age range between 6 and 11 years, 106 (47.53%) between 12 and 18 years, and 33 (14.80%) were older than 18 years.

Disease duration was of 1–2 years in 15 cases (6.73%), of 3–5 years in 78 (34.98%), of 6–10 years in 92 (41.25%), and >10 years

TABLE 2 | Reported comorbidities in the participants' offspring and symptoms rated as currently most impairing.

	Present		Currently most impairing	
	<i>n</i>	%	<i>n</i>	%
Comorbid symptoms				
Motor tics	N/A	N/A	45	22.84
Phonic tics	N/A	N/A	28	14.21
Obsessions/compulsions	106	56.08	23	11.68
Hyperactivity/inattention	103	54.50	19	9.64
Rage attacks	93	49.21	33	16.75
Anxiety	96	50.79	10	5.08
Depression	31	16.40	4	2.03
Panic	17	8.99	0	0
Learning problems	52	27.51	0	0
Sleep problems	53	28.04	5	2.54
Food problems	42	22.22	4	2.03
Other problems	24	12.70	12	6.09
None	35	15.69	14	7.11

in 38 (17.04%). TS diagnosis had been established for 1–2 years in 82 cases (36.77%), 3–5 years in 82 (36.77%), 6–10 years in 40 (17.94%), and more than 10 years in 19 (8.52%).

One hundred thirty-six (60.99%) subjects were medicated—of whom, 119 (53.36%) receiving medication for tics and 17 (7.62%) for other neuropsychiatric symptoms—while the remaining 87 (39.01%) were unmedicated at the time of the investigation.

One hundred thirteen (50.68%) subjects were receiving psychotherapy (any kind)—of whom, 66 (29.60%) for tics and 47 (21.08%) for other neuropsychiatric symptoms.

Table 2 shows the main reported comorbidities and which symptoms were rated as most impairing by parents during the lockdown period. Major pre-existing comorbidities of our sample were OCD, ADHD, anxiety, and rage attacks, with each disorder affecting about 50% of individuals. To possibly capture any other problem or symptom not otherwise specified by the survey checklist, an item “other problems” was included (**Table 2**), which needed a written specification. Symptoms recorded under such label included the following: oppositional behavior ($n = 2$), autism ($n = 1$), bipolar disorder ($n = 1$), non-suicidal self-injurious behaviors ($n = 1$), stuttering ($n = 1$), and bruxism ($n = 1$). Symptoms rated by parents as most impairing during the lockdown included mainly motor and phonic tics (22.84 and 14.21%, respectively), followed by rage attacks (16.75%), obsessions and compulsions (11.68%), and hyperactivity/inattention symptoms (9.64%).

Changes in School and Daily Activities of Offspring During the Lockdown

One hundred eighty-nine subjects (87.10%) were students and participated in online learning at home. Along with online classes, 154 of them (70.97%) were also doing individual homework. Daily, the time spent in school activities was “<1 h” in 43 cases (19.82%), “1 h” in 33 (15.21%), “2 h” in 48 (22.12%), “3 h” in 40 (18.43%), and “more than 3 h” in 53 (24.42%).

TABLE 3 | Number and percentage of offspring with reported variation of symptoms during the lockdown.

	6–11 years	12–18 years	>18 years	Total
	<i>n</i>	<i>n</i>	<i>n</i>	<i>n</i> (%)
No variation in any symptom	8	4	1	13 (6.67%)
Only improved symptoms (at least 1)	11	16	1	28 (14.36%)
Improved symptoms outnumber the worsened ones	5	4	3	12 (6.15%)
Improved symptoms equal the worsened ones	1	10	0	11 (5.64%)
Worsened symptoms outnumber the improved ones	18	13	4	35 (17.95%)
Only worsened symptoms (at least 1)	35	45	16	96 (49.23%)

Apart from school activities, parents reported of their children spending time in the following: video games (*n* 150; 69.12%), social media and chat (117; 53.92%), table or role games (64; 29.49%), playing an instrument or singing (38; 17.51%), household chores (60; 27.65%), painting (52; 23.96%), reading novels or comics (37; 17.05%), and other activities (63; 29.03%).

Variations in Clinical Symptomatology and in Parent-Child Relationship During the Lockdown

The participants were asked to report variations of clinical symptoms in their offspring during the lockdown. The variations were expressed through a 5-point Likert scale (“much improved”, “improved”, “as usual”, “worsened” and “much worsened”).

A significant worsening of the overall clinical picture occurred in two-thirds of the subjects (67.18%), while 20.51 and 5.64% experienced, respectively, an improvement or a variation with no clear trend toward improvement/worsening and only 6.67% reported no variation at all (Table 3). Most worsened symptoms (Table 4), as rated by parents in over 25% of subjects, included tics, hyperactivity, rage attacks, obsessions/compulsions, and anxiety. Nineteen participants (9.55% of respondents) also reported of other problems, such as apathy, need for physical contact, stuttering, and argumentative/defiant behavior. Of the subjects experiencing a clinical worsening, the majority (51.76%) showed variations across two to five symptom domains (Table 4).

Finally, 111 respondents (55.78%) rated the quality of their parent-child relationship during the lockdown as being “as usual,” while it “improved” for 51 (25.63%), and “worsened” for 37 (18.59%).

TABLE 4 | Type and number of “worsened” or “much worsened” symptoms during the lockdown according to age group.

	6–11 years	12–18 years	>18 years	Total
	<i>n</i>	<i>n</i>	<i>n</i>	<i>n</i> (%)
Type of symptom “worsened” or “much worsened”				
Obsessions/Compulsions	20	25	11	56 (28.28%)
Hyperactivity	33	28	7	68 (34.34%)
Rage attacks	31	23	11	65 (32.82%)
Motor tics	33	41	10	84 (42.42%)
Phonic tics	29	36	7	72 (36.36%)
Anxiety	19	21	12	52 (26.26%)
Depression	8	12	8	28 (14.14%)
Sleep problems	16	23	8	47 (23.74%)
Panic	7	5	4	16 (8.08%)
Eating problems	11	20	7	38 (19.19%)
Number of symptoms “worsened” or “much worsened”				
0	19	20	2	41 (20.81%)
1	9	16	5	30 (15.23%)
2	15	13	3	31 (15.75%)
3	10	13	5	28 (14.21%)
4	12	15	3	30 (15.23%)
5	5	6	2	13 (6.59%)
6	7	4	3	14 (7.11%)
7	1	2	0	3 (1.52%)
8	2	2	0	4 (2.03%)
9	0	1	1	2 (1.01%)
10	0	0	1	1 (0.51%)

Associations

Contingency tables showed only few definite associations between the categorical variables listed in Methods and the variation either of symptoms of TS or of the quality of parent-child relationships during the lockdown.

In particular, a younger participant’s age was associated to a worsening in the relationship with their child (33.33 vs. 17.82 vs. 7.69% in participants aged ≤ 40 years, 41–50 years, and > 50 years, respectively; $p = 0.0141$). In addition, the quality of the parent-child relationship was associated to the presence of domestic helps before the pandemic, in that “improvement” and “worsening” of the relationship were respectively higher in the group of participants without and with domestic helps (improvement, 42.25%; worsening, 25.35%; $p < 0.001$). Finally, a shorter time dedicated to school activities during the lockdown was associated to a worsening of rage attacks, obsession, and compulsions and of the overall clinical symptomatology ($p = 0.0305$, $p = 0.0309$, and $p = 0.0415$, respectively).

DISCUSSION

Based on parent reports among a national sample, the present study highlights the adverse impact of the COVID-19 pandemic on mental health of individuals with TS.

Although limited by its cross-sectional design, our study points out an important worsening of the overall clinical condition in the time window of 4–6 weeks after the beginning

of the lockdown. Specifically, over 67% of parents reported worsening of TS symptoms, while only 20.5 and 6.7%, respectively observed improvement or no variation of the clinical picture. Such large and definite trend toward worsening in our sample seems unlikely related to the polyphasic course of TS, with the typical fluctuations in the severity of tics and associated symptoms. Furthermore, our data do not support any association between variation of symptoms and family health and economic issues related to the pandemic. The latter aspect might reflect either a lack of statistical power of our data or the involvement of other factors contributing to adverse mental health outcomes in our cohort, such as the condition created by the lockdown itself and the inherent daily life disruption.

Tics, especially motor ones, were rated in up to 42% of cases as the most worsened symptoms. As a general rule, individuals with TS tend to tic less when they are engaged in social situations (e.g., school or work settings) and more when they are relaxed or with family (14, 15). In line with this evidence, our data suggest that the prolonged stay-at-home condition during the lockdown may have contributed to tic exacerbation.

Importantly, the specific population here examined was part of a larger community experiencing a collective stressful life event such as the COVID-19 pandemic. Psychosocial stress and adverse life events have been largely implicated not only in tic frequency and severity (16) but also in the worsening of comorbid depression and anxiety in TS (17). Accordingly, we observed an increase of anxiety and obsessive-compulsive symptoms (OCS) in 26 and 28% of our sample. However, our findings indicate that anxious-depressive symptoms were outweighed by externalizing and behavioral problems. Indeed, outbursts of anger ("rage attacks") and problems related to hyperactivity/impulsivity, regarded almost 32–34% of the subjects and especially those in the younger age groups (6–11 and 12–18 years old). Such different rates of externalizing and internalizing problems parallel the findings from previous studies on hospitalized patients put into isolation [for a review (18)], showing that, while adults were more at risk for depression and general anxiety disorder, children presented more often with externalizing and disruptive behaviors. Of note, if compulsions and anxiety may represent dysfunctional coping strategies aimed at gaining control over a situation of unexpected threat (19), anger, and irritability have also been associated in children and youths with biased attention toward threatening information (20–22). Against this background, our findings support that the stressful conditions established by the lockdown, such as habit and social contact disruptions, may have acted as threat cues for patients, exacerbating dysfunctional behavioral and emotional responses.

Adding to this, we found an inverse relation between time dedicated to school activities during lockdown and the overall clinical symptomatology (i.e., shorter time dedicated to schoolwork was significantly related to greater worsening of symptoms, most notably rage attacks and OCS). Intuitively, subjects facing greater symptom exacerbation during the lockdown may have been more prone to concentration issues. Also, a reduced time for sport and physical activity, given their positive impact on well-being (23) and learning achievements in children (24), may have influenced the amount of time dedicated

to remote learning and the general mental health of our sample. Taken together, the worsened clinical condition and the reduced possibility of physical exercise may have impacted on the time spent in schoolwork by patients in our cohort, with a shift toward activities such as video games and social networking, as already reported in a population-based study on Middle Eastern Respiratory Syndrome (MERS) (25).

Finally, the present study outlines no negative effect of prolonged stay at home on parent-child relationships, which are referred as stable or even improved in the large majority of cases. In this regard, the only variable correlating to worsening was the presence of extended family help before the pandemic (i.e., grandparents/relatives looking after the child), which was presumably disrupted due to lockdown requirements.

Our study has several limitations, although some are common to the survey methodology. The choice of a digital survey was motivated by the need to rapidly reach out to a greater group of individuals living in areas of the country that were differently affected by the pandemic. As for surveys in general, our study has been prone to response biases which affect accuracy and consistency of the results. Nevertheless, to partly control for random answers and increase responders' reliability, we launched the survey through an advocacy group website, thus attempting to gather data from individuals who were familiar with and interested in the topic of tic disorders. Given such demographic aspects, referral biases were also possible (i.e., a higher participation in the survey by those living the more stressful situations). However, our data revealed a considerable number of cases reported as stable or even improved. This issue also suggests the possibility of a mitigation effect played by the lockdown on tics and related symptoms in a specific subgroup of individuals. Whether a determinant or a consequence of negative social interactions, many children with tics experience high social anxiety (26, 27). Thus, reduction of societal stress due to limited social exposure may have been at play in part of the variance observed.

Finally, the cross-sectional and anonymous nature of our data has hindered the possibility of a follow-up. Future studies on longitudinal cohorts would clearly add deeper insight on long-term mental health impact of the current pandemic in selected subpopulations.

Taking into account these limitations, our study highlights that, for a substantial percentage of patients with TS, the lockdown imposed by the COVID-19 pandemic has been an extremely difficult period characterized by the worsening of the overall clinical condition. Remarkably, though based only on qualitative data, the increase of behavioral and emotional symptoms in our sample seems to parallel the increase in tic severity, which might be interpreted as a sign of the interrelatedness of symptoms in the broader TS spectrum.

There is a compelling need to carefully observe how this epochal event may impact on mental health and natural course of TS in the long term. In view of possible future lockdowns and prolonged stay-at-home orders, health authorities and clinicians should be aware of the risks for mental health in vulnerable populations, in order to ensure appropriate healthcare without undermining public health needs.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

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AUTHOR CONTRIBUTIONS

GC and VB contributed to the conception, design of the study, and wrote the first draft of the manuscript. GC, VB, and FV organized the database. FCh performed the statistical analysis. FCa contributed to the conception, design of the study, and revised the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

ACKNOWLEDGMENTS

We are grateful to the families who participated in the survey.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Tele-Psychiatry Assessment of Post-traumatic Stress Symptoms in 100 Patients With Bipolar Disorder During the COVID-19 Pandemic Social-Distancing Measures in Italy

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OPEN ACCESS

Edited by:

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 06 July 2020

Accepted: 03 November 2020

Published: 03 December 2020

Citation:

Carmassi C, Bertelloni CA, Dell'Oste V,
Barberi FM, Maglio A, Buccianelli B,
Cordone A and Dell'Osso L (2020)
Tele-Psychiatry Assessment of
Post-traumatic Stress Symptoms in
100 Patients With Bipolar Disorder
During the COVID-19 Pandemic
Social-Distancing Measures in Italy.
Front. Psychiatry 11:580736.
doi: 10.3389/fpsy.2020.580736

The acute phase of the COrona Virus Disease-19 (COVID-19) emergency determined relevant stressful burdens in psychiatric patients, particularly those with chronic mental disorders such as bipolar disorder (BD), not only for the threat of being infected but also for the strict lock-down and social-distancing measures adopted, the economic uncertainty, and the limited possibilities to access psychiatric services. In this regard, telepsychiatry services represented a new important instrument that clinicians could adopt to monitor and support their patients. The aim of the present study was to investigate acute post-traumatic stress symptoms (PTSS) reported by patients with BD followed in the framework of a telepsychiatry service, set up in the acute phase of the COVID-19 outbreak at the psychiatric clinic of the University of Pisa (Italy). A sample of 100 patients were consecutively enrolled and assessed by the IES-r, GAD-7, HAM-D, and YMRS. Patients reported a mean ($\pm$ SD) IES-r total score of 18.15 ± 13.67 . Further, 17% of the sample reported PTSS (IES-r > 32), 17% depressive symptoms (HAM-D > 17), and 26% anxiety symptoms (GAD-7 > 10). Work and financial difficulties related to the COVID-19 pandemic and anxiety symptoms appeared to be positively associated with the development of acute PTSS. Acute manic symptoms appeared to be protective. The data of the present study suggest the relevance of monitoring patients with BD exposed to the burden related to the COVID-19 outbreak for prompt assessment and treatment of PTSS.

Keywords: tele-psychiatry, post-traumatic stress symptoms, COVID-19, bipolar disorder, mood disorder, pandemic

INTRODUCTION

Increasing literature suggests how COVID-19 and the related quarantine or social-distancing measures, adopted in the acute phase, may have represented a traumatic experience that could have affected mental health and well-being of exposed individuals (1, 2). At the end of April 2020, after 55 days of national lock-down during the so-called *first phase* of the pandemic, in Italy the number of COVID-19 cases exceeded 200,000 units and the death count 31,000 units. During this period, most of the population lived in home-confinement environments

avoiding social interactions, and the COVID-19 outbreak may have represented a relevant trauma not only for the risk of being infected but also for the strict lock-down and social-distancing measures, the economic uncertainty, and the limited possibilities to access mental health services. The first studies investigating mental health stress burden on a general population exposed to the COVID-19 pandemic showed high levels of depression, anxiety, and post-traumatic stress symptoms (PTSS) (3–7). Particularly, Liu et al. (5) reported a 7% prevalence rate of clinically significant PTSS in the Chinese general population living in the hardest-hit areas during the COVID-19 epidemic. Another recent study showed post-traumatic stress disorder (PTSD) and depression rates of 2.7 and 9.0%, respectively, among 2,485 home-quarantined Chinese University students (6).

Despite the fact that psychological burden of the COVID-19 emergency has been very different across different countries and strongly related to specific regional conditions (5, 8), it seems very likely that the pandemic will affect long-term mental health in populations with low degree of resilience, such as patients with chronic psychiatric disorders such as bipolar disorder (BD). Comorbidity between BD and PTSD has been widely investigated in the literature, showing prevalence rates ranging between 4 and 40% for PTSS, and between 9 and 20% for PTSD diagnosis (9, 10).

As the general population, subjects affected by pre-existing mental disorders faced several stressors during the period of national lockdown in Italy, such as isolation, loneliness, sudden bereavement without being able to bury their loved ones, and fear of ultimately and suddenly losing their own lives (11). Despite the fact that some authors did not find any detrimental effect of the COVID-19 outbreak on the social inclusion and well-being in subjects with mental health problems (12), pandemic concerns might have represented a significant stressor, particularly for subjects with severe mental illness, which were vulnerable to the risk of anxiety and mood relapse (13). Further, social distancing limited access to treatment and support centers, including mental health services, day programs, and congregate care settings, as well as limiting contact with families and loved ones, enduring increasingly prohibitive visitor policies (13–16). On one hand, some individuals with severe mental disorders might have been less impacted by the public health restrictions, because they lived already “socially distanced,” with minimal interpersonal contacts outside of their immediate living environment and necessities, whether as a result of their symptoms, societal marginalization, or personal choice; on the other hand, in most of these patients the lockdown measures further reduced and collapsed the weak existing social networks (17). Consistently, Hao et al. (11) reported more severe acute PTSS, anxiety, and depression symptoms among Chinese psychiatric patients during the peak of the COVID-19 epidemic with strict lockdown measures than in healthy controls, with more than one-quarter of patients reporting PTSS.

A major issue for clinicians and researchers in psychiatry is now to detect which impact the COVID-19 pandemic will have on psychiatric long-term care going forward. The sudden changes occurred could have significantly impacted psychiatric patients' mental health as well as having reduced their opportunity to access psychiatric services (13, 16). Because of the pandemic,

psychiatric inpatients were exposed to a high risk of COVID-19 infection. Consequently, most of the psychiatric patients in maintenance phase or with minor symptoms received their treatment at home to reduce the risk of infection, and clinicians first adopted telepsychiatry services to monitor their patients (13, 18, 19). Further, a significant portion of psychiatric patients that were quarantined in their homes resulted in social isolation and loneliness, which could fuel anxiety and mood destabilization secondary to physical distancing and shelter-in-place guidelines. Therefore, connecting with these individuals seemed essential to provide treatment for acute psychiatric concerns as well as to continue treatment of chronic illness. Nowadays, a rich literature supports telepsychiatry, demonstrating excellent acceptance and non-inferior outcomes across ages, conditions, cultures, and languages (20). Remote consultation via telemedicine to overcome the rules of social distancing during the peak of the COVID-19 pandemic had been rapidly embraced in several countries (8, 21–23) and operational instructions for mental health departments and community hospitals, such as tele-health and phone check-ins, had been also promptly set up in some hospitals in Italy, including the psychiatric clinic of the University of Pisa, during the acute phase of the pandemic (24, 25).

To date there is still a lack of data on the impact of COVID-19 pandemic on psychiatric patients, particularly on those affected by BD. The aim of the present study was to examine the psychopathological impact experienced by BD patients assessed in a telepsychiatry setting displaced during the peak of the COVID-19 epidemic and the strict lockdown and social-distancing measures in a major University hospital in central Italy (Pisa). In particular, we focused on the investigation of PTSS developed in response to the COVID-19 emergency and on the possible factors associated with them.

METHODS

Study Sample and Procedures

The present cross-sectional study included a consecutive sample of 100 subjects with a *DSM-5* diagnosis of BD enrolled at the adult outpatient psychiatric service of the Azienda Ospedaliera Universitaria Pisana (AOUP, Pisa, Italy) while followed in the framework of a telepsychiatry service, set up during the acute phase of the COVID-19 pandemic. This specific service was introduced from 1 March 2020 to carry on the psychiatric care of BD patients followed at the AOUP, during the lockdown phase of the COVID-19 emergency. Patients with a manic episode, severe depression, catatonia, active alcohol or substance abuse, or cognitive impairment were excluded from the telepsychiatric service. Patients were contacted once a week by an expert psychiatric clinician (BB, BFM, CA, and MA) for psychiatric control visits. The study enrollment and assessment were conducted from 1 April 2020 to 30 April 2020. Patients were evaluated in the framework of the telepsychiatry visit. All eligible subjects were asked to provide written informed consent after receiving a complete description of the study and they had the opportunity to ask questions. The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Area Vasta Nord-Ovest Toscana (Italy).

Instruments and Assessments

All subjects were assessed by means of the Impact of Event Scale- Revised (IES-r) (26) to investigate PTSS; Generalized Anxiety Disorder 7-Item (GAD-7) (27) to explore anxiety symptoms; the Hamilton Depression Rating Scale (HAM-D) (28) to evaluate depressive symptoms; and Young Mania Rating Scale (YMRS) (29) to examine manic symptoms. We also gathered the socio-demographical and clinical data through a specific datasheet reporting information on the COVID-19 pandemic. Expert psychiatric clinicians (BB, BFM, CA, and MA) performed clinical interviews and ratings, while self-report scales were sent to patients by email, completed, and then sent back immediately after the visit.

The IES-r is a 22-item scale measuring three core features of PTSD (re-experiencing of traumatic events, avoidance, and hyperarousal) and thus items, coded on a 0–4 scale, are divided into three subscales: *intrusion*, *avoidance*, and *hyperarousal*. All items refer to the last week prior to the assessment. The questionnaire has an adequate internal consistency and high test-retest reliability ($r = 0.93$). The mean score of the items of each subscale determines the subscale score. The IES-r total score is calculated adding the score of each item. A score over 32 represents a cutoff for PTSS (30). In accordance with the aim of the study, the items referred to the traumatic events that the subjects had experienced in the framework of the COVID-19 pandemic.

The GAD-7 is a self-assessment questionnaire used as a tool for screening and measuring the severity of anxious symptoms. Particularly, it investigates the frequency of anxious symptoms in the last 2 weeks using seven items with a score ranging from 0 (never) to 3 (almost every day). In the validation study, the internal consistency of the scale was excellent ($\alpha = 0.92$). Scores over 10 suggest the presence of moderate to severe anxiety symptoms.

The HAM-D is the most widely used clinician administered scale to evaluate the presence and the severity of depressive symptoms. It consists of 21 items, some of which are assessed on scales from 3 to 5 points, with well-defined severity levels. The total score is assessed on the first 17 items, and a score over 17 suggests the presence of moderate–severe depression.

The YMRS is the most widely clinician administered scale used for the assessment of the severity of manic symptoms. The scale is composed by 11 items: four items are graded on a 0–8 scale, while seven items are graded on a 0–4 scale. The score for each item is summed to obtain the YMRS total score and a score over 20 is usually considered a cut-off for a manic episode. Internal consistency of the instrument is good ($\alpha = 0.72$).

Statistical Analysis

Continuous variables were reported as mean $\pm$ standard deviation (SD), whereas categorical variables were reported as percentages. All tests were two-tailed and a p -value < 0.05 was considered statistically significant. All statistical analyses were performed using the Statistical Package for Social Science, version 25.0 (SPSS Inc.).

Chi-square test (or Fisher test if appropriate) was computed to compare socio-demographical and clinical characteristics

between individuals with and without PTSS. We computed the non-parametric Mann-Whitney test for the comparisons between subjects with PTSS and those without PTSS of the not normal distributed variables GAD-7, HAM-D, and YMRS scores.

A multiple logistic regression model was utilized to study the strongest predictor of PTSS (dependent variable) among the predictors associated with PTSS in the univariate analysis. Accordingly, gender, work, or social difficulties due to the lockdown, GAD-7, HAM-D, and YMRS total scores were used as independent variables.

RESULTS

The sample included 36 (36%) males and 64 females (64%). The mean age was 47.04 ± 16.18 (min 19, max 81, median 48). Thirty-eight subjects (38%) were married or cohabiting, 23 (23%) lived alone, 17 (17%) had a University degree, and 48 (48%) were employed. Furthermore, 80 (80%) had a psychiatric family history, 23 (23%) reported a comorbid DSM-5 anxiety disorder, and 6 (6%) a DSM-5 obsessive-compulsive disorder. For what concerned the psychopharmacological treatment: 78 (78%) were on antidepressants, 88 (88%) mood stabilizers, 58 (58%) antipsychotics, and 23 (23%) benzodiazepines.

In the framework of the COVID-19 pandemic, 31 subjects (31%) reported to be at risk for medical complications in the case of the COVID-19 infection, one (1%) was positive to COVID-19, and 27 (27%) reported work and economic difficulties due to the lockdown. Moreover, 32 individuals (32%) had a close one at risk of the COVID-19 infection, 8 (8%) a relative or a close one infected by COVID-19, and 3 (3%) a loss of a relative or a close one by COVID-19. Socio-demographical and clinical characteristics of the sample are summarized in **Table 1**.

In the total sample the IES-r total score was 18.15 ± 13.67 , while the *intrusion*, *avoidance*, and *hyperarousal* subscales scores were 0.81 ± 0.68 , 0.77 ± 0.70 , and 0.91 ± 0.68 , respectively. Seventeen subjects (17%) reported PTSS. Particularly, PTSS was significantly higher in females than in males [15 (23.4%) vs. 2 (5.6%), $p = 0.045$] and in patients who reported work or financial difficulties due to the lockdown with respect to those who didn't experienced it [10 (37.0%) vs. 7 (9.6%), $p = 0.002$]. The mean ($\pm$ SD) GAD-7, HAM-D, and YMRS scores were 6.93 ± 4.73 , 10.40 ± 6.42 , and 2.58 ± 3.44 , respectively. Subjects with PTSS showed significant higher GAD-7 (6.01 ± 3.99 vs. 11.41 ± 5.57 , $p < 0.001$) and HAM-D (9.36 ± 5.89 vs. 15.47 ± 6.66 , $p < 0.001$) scores with respect to those without PTSS. Twenty-six (26%) subjects showed moderate to severe anxiety symptoms, 10 (58.8%) with PTSS and 16 (19.3%) without PTSS ($p = 0.002$). Moderate/severe depressive symptoms were reported by 17 (17%) subjects, 7 (41.2%) with PTSS and 10 (12.0%) without PTSS ($p = 0.008$). No subjects reported a manic episode (see **Table 2** for details).

In a logistic regression model, considering gender and work and economic difficulties, besides the GAD-7, HAM-D, and YMRS scores as independent variables, and the PTSS as the dependent variables, the work and economic difficulties [$b = 1.641$ (SE = 0.757), $p = 0.030$], the GAD-7 [$b = 0.233$

TABLE 1 | Socio-demographical and clinical characteristics in the total sample ($N = 100$), patients with ($N = 17$) and without ($N = 83$) acute PTSS.

	Total Sample <i>N</i> (%)	No-PTSS <i>N</i> (%)	PTSS <i>N</i> (%)	<i>p</i>
Age > 48	50 (50%)	10 (51.2%)	7 (41.2%)	0.626
Females	64 (64%)	49 (59.0%)	15 (88.2%)	0.045
Married/cohabiting	38 (38%)	33 (39.8%)	5 (29.4%)	0.599
Living with family	23 (23%)	64 (77.1%)	13 (76.5%)	0.594
University degree	17 (17%)	14 (16.9%)	3 (17.6%)	1.000
Employed	48 (48%)	39 (47.0%)	9 (52.9%)	0.856
Psychiatric Family History	80 (80%)	64 (77.1%)	16 (94.1%)	0.182
Anxiety Disorder	23 (23%)	17 (20.5%)	6 (35.3%)	0.314
Obsessive Compulsive Disorder	6 (6%)	6 (7.2%)	0 (0%)	0.586
Antidepressant	78 (78%)	62 (74.7%)	16 (94.1%)	0.109
Mood Stabilizer	88 (88%)	75 (90.4%)	13 (76.5%)	0.119
Antipsychotic	58 (58%)	51 (61.4%)	7 (41.2%)	0.203
Benzodiazepine	23 (23%)	19 (22.9%)	4 (23.5%)	1.000
Being at risk for medical complications related to COVID-19 infection	31 (31%)	26 (31.3%)	5 (29.4%)	1.000
Positive to COVID-19	1 (1%)	1 (1.2%)	0 (0%)	1.000
Work or financial difficulties due to the quarantine and social-distancing measures	27 (27%)	17 (20.5%)	10 (58.8%)	0.002
A relative or close one at risk for medical complications related to COVID-19 infection	32 (32%)	24 (28.9%)	8 (47.1%)	0.249
A relative or close one positive for COVID-19	8 (8%)	6 (7.2%)	2 (11.8%)	0.621
Loss of a relative or close one from COVID-19	3 (3%)	2 (2.4%)	1 (5.9%)	0.432

($SE = 0.110$), $p = 0.034$], and YMRS [$b = -0.301$ ($SE = 0.143$), $p = 0.036$] total scores showed a statistically significant association with the PTSS. See **Table 3**.

DISCUSSION

The present study first explored the onset of acute PTSS, anxiety, and depressive symptoms in a sample of 100 patients with BD evaluated in the framework of a telemedicine service set up in the acute phase of the COVID-19 pandemic in Italy, during the period of national lockdown and ongoing social distancing measures. Seventeen patients reported PTSS, while 26 showed moderate to severe anxiety symptoms and 17 moderate to severe depressive symptoms. Work and financial difficulties, besides anxiety symptoms, appeared to be positively associated with the development of PTSS. Interestingly, acute manic symptoms seemed to be protective.

In the present study, PTSS rates were lower than those found in the majority of previous studies on patients with BD (9, 10). This difference may be related to several factors, such as the unique nature of the traumatic event “pandemic,” the assessment of PTSS in the framework of the acute phase of

TABLE 2 | Comparison of GAD-7, HAM-D, and YMRS total scores between subjects with ($N = 17$) and without ($N = 83$) acute PTSS.

	Total Sample mean $\pm$ SD	No-PTSS mean $\pm$ SD	PTSS mean $\pm$ SD	<i>p</i>
GAD-7	6.93 $\pm$ 4.73	6.01 $\pm$ 3.99	11.41 $\pm$ 5.57	<0.001
HAM-D	10.40 $\pm$ 6.42	9.36 $\pm$ 5.89	15.47 $\pm$ 6.66	<0.001
YMRS	2.58 $\pm$ 3.44	2.65 $\pm$ 3.54	2.23 $\pm$ 3.01	0.645
	<i>N</i> (%)	<i>N</i> (%)	<i>N</i> (%)	
Moderate/severe anxiety symptoms	26 (26)	16 (19.3)	10 (58.8)	0.002
Moderate/severe depressive symptoms	17 (17)	10 (12.0)	7 (41.2)	0.008
Moderate/severe manic symptoms	0 (0)	–	–	–

TABLE 3 | Logistic regression model: Gender, work, or economic difficulties GAD-7 score, HAM-D score, and YMRS score as predictive variables associated with acute PTSS in the total sample ($N = 100$).

Predictive factors	<i>b</i> (S.E.)	β	CI 95%	<i>p</i>
Gender	1.037 (0.946)	2.820	0.441–18.028	0.273
Work or financial difficulties due to the quarantine and social-distancing measures	1.641 (0.757)	5.158	1.171–22.723	0.030
GAD-7	0.233 (0.110)	1.263	1.017–1.567	0.034
HAM-D	0.089 (0.070)	1.093	0.953–1.253	0.202
YMRS	–0.301 (0.143)	0.740	0.559–0.980	0.036
K	–5.345 (1.201)	0.005	–	0.000

$R^2 = 0.279$; R^2 corrected = 0.466. Global-goodness-fit percentage = 89.0%.

the pandemic threat, or the euthymic state of the patients at the beginning of the lockdown phase. Nevertheless, these rates appear to be worth clinical attention, considering that PTSS was associated with increased clinical severity of the BD, suicidal behaviors, and worsened quality of life (9, 31, 32). Further, the continuous support and the monitoring provided to the subjects by the tele-psychiatric service might be useful in preventing or attenuating the development of such PTSS (33, 34). As we expected, female patients showed higher PTSS rates than male ones. This result is in line with recent studies on the COVID-19 emergency, reporting greater PTSD rates among females (35). It is well-recognized that female gender is associated with greater vulnerability to development of pathological reactions following traumatic or stressful events, both in the general population (36, 37) and in individuals with BD (9, 38). Interestingly, work and financial problems appear to be strictly associated with PTSS symptom severity. Several authors highlighted the relationship between unemployment or financial difficulties and poor mental health outcomes, such as depression, anxiety, or suicide behaviors (39–41). Elbogen et al. (42), in a sample of 1,388 Iraq and Afghanistan War Veterans, found that subjects with poor money incomes were significantly more likely to be affected by PTSD and to report a wide range of reckless, impulsive, or self-destructive behaviors. The impact of low economic status on

the development of acute PTSS or PTSD was also reported after traumatic injury (43) or mass trauma (44). Furthermore, PTSS *per se* can affect global functioning levels, work abilities, and consequently the socioeconomic status (42, 45). In this vicious cycle, the results of the present study highlight the relevance of early detection and treatment of PTSS and PTSD, also in consideration of the possible economic implications in the long-term of the COVID-19 pandemic not yet overcome.

In regard to the other psychopathological features of the sample, we observed substantial percentages of anxiety and depressive symptoms, especially in patients reporting PTSS. High rates of depression and anxiety emerged in several different populations during the COVID-19 pandemic (4–6, 46, 47) and our data corroborated the assumption that they represented, together with PTSS, the most common psychopathological reactions to the outbreak. Furthermore, the greater depressive and anxiety symptoms burden among subjects with PTSS is so well-recognized in literature that a lively debate is ongoing on the boundaries between these disorders (37, 48). We also found low rates of manic symptoms in the sample during the acute phase of the pandemic. However, to the best of our knowledge, there is still a lack of data on this topic, so it is not easy to compare our results. Previous studies explored depressive or manic reactions related to other categories of traumatic or stressful events. However, these studies focused not on the acute phase but later on in the aftermath of a traumatic event. Particularly, some authors pointed out that in patients with BD, negative life events, such as job loss, bereavement, or personal issues, could worsen not only depressive symptoms but also manic ones (31, 49, 50). In the present study, the quarantine and social-distancing measures related to the COVID-19 pandemic showed to be less likely related to a manic-hypomanic episode, and a possible interpretation of this result could suggest an effective role of tele-psychiatry monitoring, and the consequent treatment changes, in preventing or alleviating manic manifestations.

Surprisingly, the presence of manic symptoms appeared also to be protective for the development of PTSS. This result is in contrast with existent literature on the role of manic/hypomanic state during a traumatic event as a vulnerability factor for the subsequent onset of PTSD symptoms (51–54). Nevertheless, it is worth noticing that manic symptoms levels in the present study were low, with no patient reaching the threshold for manic episode. Furthermore, the relationship between the presence of these symptoms and the development of future PTSD cannot be determined with our data and needs to be further assessed. Conversely, in the regression analysis financial difficulties and anxiety symptoms were associated with PTSS. In particular, a great amount of research reported that anxiety, fear, and distress

at the time of the trauma were strictly associated with the development of post-traumatic stress reactions (55). Comorbid anxiety was related to an increased risk of PTSD onset both in general population and in longitudinal studies on BD patients (51, 52, 56). Our results corroborate these previous findings in a bipolar sample exposed to the “COVID-19 outbreak” event.

Some limitations should be kept in mind when interpreting the results of the study. The first limitation was the small sample size. However, we may argue that it represented the first homogeneous sample of subjects with BD followed in a telemedicine service during the COVID-19 pandemic. Second, we took advantage of self-report instruments to detect PTSS and anxiety that could be considered less accurate than a clinician assessment. Third, not all possible confounders and relevant COVID-19 related stressors were considered, and thus further studies may be warranted. Finally, the lack of a control group not followed in tele-psychiatry did not allow us to investigate the efficacy of this methodology beyond speculation. However, evaluation of efficacy was not an aim of the study.

In conclusion, the stress related to the acute phase COVID-19 outbreak could lead patients with a severe psychiatric disorder, such as BD, to develop psychopathological reactions such as depression, anxiety, and PTSS. Our results suggest that females who experienced work or financial difficulties may need greater attention in order to prevent possible PTSS. Further studies are needed to assess the psychopathological trajectories of patients with BD after the COVID-19 pandemic and the possible therapeutic strategies that could be useful to prevent negative outcomes in this population.

DATA AVAILABILITY STATEMENT

The data supporting the findings of the article are not publicly available, but it can be provided by the corresponding author on reasonable request.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Comitato Etico Regionale per la Sperimentazione Clinica della Regione Toscana AREA VASTA NORD OVEST (CEAVNO, Pisa, Italy). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors gave substantial contribution to the study and approved the final version of the manuscript and the manuscript submission to Frontiers in Psychiatry.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Facing Loneliness and Anxiety During the COVID-19 Isolation: The Role of Excessive Social Media Use in a Sample of Italian Adults

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OPEN ACCESS

Edited by:

Carlo Lai,
Sapienza University of Rome, Italy

Reviewed by:

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Cuore, Italy
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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 22 July 2020

Accepted: 10 November 2020

Published: 08 December 2020

Citation:

Boursier V, Gioia F, Musetti A and
Schimmenti A (2020) Facing
Loneliness and Anxiety During the
COVID-19 Isolation: The Role of
Excessive Social Media Use in a
Sample of Italian Adults.
Front. Psychiatry 11:586222.
doi: 10.3389/fpsy.2020.586222

The outbreak of coronavirus disease 2019 (COVID-19) prompted people to face a distressing and unexpected situation. Uncertainty and social distancing changed people's behaviors, impacting on their feelings, daily habits, and social relationships, which are core elements in human well-being. In particular, restrictions due to the quarantine increased feelings of loneliness and anxiety. Within this context, the use of digital technologies has been recommended to relieve stress and anxiety and to decrease loneliness, even though the overall effects of social media consumption during pandemics still need to be carefully addressed. In this regard, social media use evidence risk and opportunities. In fact, according to a compensatory model of Internet-related activities, the online environment may be used to alleviate negative feelings caused by distressing life circumstances, despite potentially leading to negative outcomes. The present study examined whether individuals who were experiencing high levels of loneliness during the forced isolation for COVID-19 pandemic were more prone to feel anxious, and whether their sense of loneliness prompted excessive social media use. Moreover, the potentially mediating effect of excessive social media use in the relationship between perceived loneliness and anxiety was tested. A sample of 715 adults (71.5% women) aged between 18 and 72 years old took part in an online survey during the period of lockdown in Italy. The survey included self-report measures to assess perceived sense of loneliness, excessive use of social media, and anxiety. Participants reported that they spent more hours/day on social media during the pandemic than before the pandemic. We found evidence that perceived feelings of loneliness predicted both excessive social media use and anxiety, with excessive social media use also increasing anxiety levels. These findings suggest that isolation probably reinforced the individuals' sense of loneliness, strengthening the need to be part of virtual communities. However, the facilitated and prolonged access to social media during the COVID-19 pandemic risked to further increase anxiety, generating a vicious cycle that in some cases may require clinical attention.

Keywords: anxiety, isolation, loneliness, excessive social media use, COVID-19

INTRODUCTION

The outbreak of coronavirus disease 2019 (COVID-19) generated a global health crisis, prompting people to face a distressing and unexpected situation. The risk of contamination and the experience of social distancing changed people's behaviors and deeply impacted individual feelings, daily habits, and relationships. Uncertainty about the timeline of the growing pandemic strengthened people's fears (1–3), stress, and confusion (4). Isolation and restrictions due to quarantine worsened feelings of anxiety and loneliness among both older and younger populations (1, 5). Since the first weeks of COVID-19 diffusion, scholars worldwide have started to investigate how the pandemic has been impacting mental health (6–12) and has been forcing individuals to cope strategically with their isolation (13). Indeed, the loss of one's usual routine and reduced social contacts may cause boredom, frustration, and a sense of isolation, which can generate high levels of distress in individuals increasing the risk of mental disorders, such as anxiety, mood, addictive, and thought disorders (14–21). In this regard, a strong participation of mental health professionals in the management of the crisis and post-crisis has been warmly recommended, in order to help people facing the stressful circumstance and its risky consequences (6, 20).

The subjective sense of loneliness describes individuals' disagreeable feeling of having a lack of meaningful social relationships (22–24), concerning both quantity and quality of social contacts (25, 26). Even though the subjective feeling of being lonely does not overlap with objective social isolation (24, 27), social isolation is undoubtedly one of the strongest predictors of loneliness and has negative effects on both health and well-being (28). Indeed, social inaction and resultant isolation frequently worsen individuals' sense of loneliness (29).

Several studies have examined sociodemographic and contextual variables related to loneliness, such as age and social status, highlighting that different life circumstances are meaningfully associated with loneliness (30–36). In particular, difficult life conditions and drastic changes in social contexts have been linked to increased social and emotional loneliness (37–39). In any case, loneliness seems to reflect an individual's unsatisfied desire to enjoy close contacts with people and to be embedded in significant relationships; thus, it represents an individual's failure in social domains of life that play a key role in human well-being (24). Indeed, perceived feelings of loneliness have been reported as a specific risk factor for anxiety and chronic stress (24, 40, 41), as well as for high engagement in unhealthy behaviors (10, 42). Additionally, social isolation and loneliness have been positively associated with anxiety in both older adults and youth (29, 43), and negatively associated with happiness, well-being, and life satisfaction (44–46). However, some research also suggests that individuals with high emotional loneliness are more prone to engage in adaptive coping behaviors, such as creating new social interactions (47).

Social relationships are core elements in people's lives. Thus, how individuals cope with loneliness during forced isolation is important to the debate (48, 49). Within this context, the use of digital technologies, and particularly social media, may serve

connective functions in helping individuals to increase their social capital (50, 51). Social media refers to producing, receiving, and sharing online content, including a wide range of Internet-related communication and social applications, such as online virtual games, blogs, e-health forums, and social networking sites.

Social restrictions during the COVID-19 pandemic have forced individuals to face a potentially terrifying reality of isolation (1); thus, people worldwide have been invited to be socially (but not physically) connected (52). Even the American Psychological Association (APA) has promoted connections via social media platforms for safety and to be informed and relieve stress during the COVID-19 pandemic (53). Indeed, social media can play a key positive role in communication by allowing people to feel that they are not alone but part of a community (1). Additionally, social media have been proposed as tools for alleviating anxiety among individuals, even though the specific effects of social media consumption need to be carefully addressed (54). For instance, analytics company Sprinklr reported nearly 20,000,000 people mentioning coronavirus-related terms on social media in the last months (55), highlighting the heavy role of COVID-19 on people's cognition and behaviors. Within this context, the World Health Organization (WHO) reported about the risks of the “infodemic” causing information overload and widespread anxiety during the pandemic (56, 57) and thus recommended calling on official information sites to avoid excess or incorrect information (58). Likewise, the risk of a “digital epidemic” has been evidenced (59), which must be stemmed by using technology creatively (54) and by moderating media exposure and consumption, to prevent people from becoming overwhelmed (53).

In this regard, social media use highlights clear—yet risky—opportunities (60), depending on its specific use or misuse, for individuals to face isolation through social connection and quench their own thirst for knowledge and communication. Indeed, excessive media consumption and steady health messaging on COVID-19's diffusion and consequences are exacerbating factors on individuals' mental health (8). Previously, negative feelings have been extensively associated with excessive social media use and digital addiction (61–70). In particular, loneliness is a risk factor related to problematic engagement in Internet-related activities (63, 71–75) and as one of the most important predictors of problematic Internet and social networking site use (76, 77). In fact, lonely individuals may see the online environment as an ideal place for increasing their opportunities for interaction and belonging (78, 79), but this use may sometimes become maladaptive and excessive.

In fact, a worrisome and vicious cycle between loneliness and excessive Internet use has been evidenced (80–84), with a bidirectional (i.e., reciprocal) relationship especially observed between loneliness and problematic social networking site use, particularly in late adolescents and adults (85). In sharp contrast, other studies have demonstrated that social media use may help people to decrease their sense of loneliness (86) while increasing their perceived social support, self-esteem, happiness, and satisfaction (87, 88). For instance, Internet use for entertainment, online communication, and social interactions may serve adolescents' and young adults' need to face their

loneliness (89, 90). Also, Sum et al. (91) reported that higher levels of emotional loneliness were associated with greater use of the Internet for social connections.

Thus, mutual connections between loneliness and individuals' responses to the COVID-19 outbreak should be better understood (8). People's levels of engagement in social media during the pandemic likely deserve attention because these levels might reflect adaptive or maladaptive responses to the distressing situation. Indeed, individuals could be highly involved in social media as a strategy to cope with their sense of loneliness, thus revealing their need to be connected with other individuals and to alleviate their negative mood. In this context, individuals' use of the online environment may alleviate negative feelings caused by distressing life circumstances, while potentially leading to problematic use and addictive-like symptoms (92). Indeed, within a compensatory model of problematic Internet-related activities, reactions to negative life circumstances are facilitated by Internet applications, which might lead to both positive (e.g., alleviating negative feelings or fulfilling the need for social contacts) and negative (e.g., reinforcing problematic engagement) outcomes (92).

The Present Study

In light of the theoretical premises and the research evidence, we hypothesized that individuals experiencing high levels of loneliness during the COVID-19 pandemic were more prone to experiencing feelings of anxiety and to be dysfunctionally involved in social media use, probably as a strategy to cope with their sense of loneliness. Consequently, we explored whether individuals experiencing high levels of loneliness during the forced isolation for COVID-19 were more prone to feel anxious and whether their sense of loneliness prompted excessive, addictive-like, use of social media. Furthermore, the mediating effect of excessive social media in the relationship between perceived loneliness and anxiety was tested.

MATERIALS AND METHODS

Participants and Procedure

A total of 715 adults responded to an online survey during the period of pandemic lockdown for COVID-19 in Italy (from the 1st to the 30th of April 2020). The sample comprised 204 men (28.5%) and 511 women (71.5%) aged between 18 and 72 years, with a mean age of 31.70 years ($SD = 10.81$). Participants were recruited through advertisements in Internet communities of Italian University students and other online groups (via social media platforms), and the groups' members were asked for dissemination in their turn. Therefore, a snowball sampling method was adopted as a recruitment strategy. The call for participation in the online study contained a website link for participants to click on to complete the questionnaire. Before filling out the survey, all of the participants were informed about the research aims and scopes and the measures to be used in generating the data. Participation was voluntary, and confidentiality and anonymity were assured. The participants could withdraw from the study at any time. No course credits or remunerative rewards were given. The study was

approved by the University Federico II (Naples, Italy). Research Ethics Committee and was conducted according to the ethical guidelines for psychological research established by the Italian Psychological Association (AIP).

Measures

Sociodemographic Information and Social Media Use Patterns

In this section, information was collected about gender, age, marital status, whether the participant was living alone during the quarantine, the most used social media, and hours per day spent on social media before and during forced isolation due to COVID-19.

Italian Loneliness Scale

The Italian Loneliness Scale (ILS) (24) is a 20-item self-report scale rated on a 4-point Likert scale (from 1 = *never* to 4 = *always*) that evaluates perceived loneliness. Eighteen items were constructed by adapting items from the widely used University of California Loneliness Scale (23) and the Dutch De Jong Gierveld Loneliness Scale (93). Additionally, two single-item criterion measures were derived *ad hoc* for the Italian scale, referring to a brief time interval (7 days), and were the last two items in the scale ("In the last 7 days, I felt unhappy or sad" and "In the last 7 days, I have seen one or more of my friends, or I heard them on the telephone"). The 20-item instrument included three subscales: (a) emotional loneliness, which comprised six items focused on emotional abandonment and missing companionship (e.g., "I experience a general sense of emptiness."); (b) social loneliness, composed of five items assessing feelings of sociability and of having significant relationships (e.g., "There are many people whom I can count on completely."); and (c) general loneliness, composed of seven items focused on feelings of isolation (e.g., "I feel isolated from others."). Due to the widespread and worsened feelings of loneliness caused by the quarantine (1, 5), for the purposes of the present study and in light of the high Pearson's r correlations among the ILS factors (0.514, $p < 0.001$ between emotional and social loneliness; 0.792, $p < 0.001$ between emotional and general loneliness; 0.642, $p < 0.001$ between social and general loneliness), a total score was generated that included emotional, social, and general loneliness, which showed an excellent Cronbach's α (0.92).

Anxiety Subscale of the Depression-Anxiety-Stress Scale-21

The Anxiety subscale of the Italian version of the Depression-Anxiety-Stress Scale-21 (DASS-21) [(94); for the original English version, see (95)] was used (e.g., "In the last 7 days, I have had breathing problems"). This subscale assesses the frequency and severity of experiencing negative emotions over the previous week on a 4-point Likert scale (from 0 = *did not apply to me at all* to 3 = *applied to me very much, or most of the time*). Cronbach's α value was good (0.86).

Bergen Social Media Addiction Scale

The Italian version of the Bergen Social Media Addiction Scale (BSMAS) [(96); original English version by (97)] was used to

evaluate problematic social media use (e.g., “How often during the last year have you spent a lot of time thinking about social media or planned use of social media?”). The BSMAS is a six-item scale rated on a 5-point Likert scale ranging from 1 (*very rarely*) to 5 (*very often*), referring to salience, mood modification, tolerance, withdrawal, conflict, and relapse. The Cronbach's α value was 0.80.

Further scales were administered to this sample, but they are not relevant for the current study and will be discussed elsewhere.

Statistical Analysis

Descriptive statistics were examined for all of the study variables. Multivariate analysis of variance (MANOVA) was used to examine the differences between men and women and between emerging adults (18–35 years) and adults (older than 35 years). Pearson's r correlations between the study variables were examined. A mediation model was tested by using Model 4 of Hayes's (98) Process Macro for SPSS, with 1,000 bias-corrected bootstrap samples to test the mediating effect of excessive social media use between participants' perceived loneliness and anxiety.

RESULTS

Descriptive Statistics

Among the participants, 55.8% were single, and only 5.9% were living alone during the quarantine. The most used social media were WhatsApp (90.2%), Instagram (64.2%), Facebook (63.6%), Facebook Messenger (16.1%), and Twitter (5.3%). Before the forced isolation due to COVID-19, 39.7% of the participants reported that they spent 1–2 h/day on social media, and only 7.4%

spent more than 4 h/day. During the quarantine, the percentage corresponding to 1–2 h/day decreased to 26.7%, and 21.2% of the participants declared that they spent more than 4 h/day on social media. The MANOVA (Table 1) exploring group differences (males/females, and emerging adults/adults) in relation to hours per day spent on social media, loneliness, anxiety, and excessive social media use showed significant differences between gender-based groups [Wilks' $\lambda = 0.98$; $F_{(4, 708)} = 4.5$; $p = 0.001$] and age-based groups [Wilks' $\lambda = 0.94$; $F_{(4, 708)} = 10.62$; $p < 0.001$]. Bivariate correlations among variables showed a significant co-occurrence of loneliness with all involved variables, especially anxiety (Table 2), with the only exception of gender.

Mediation Analysis

Concerning the tested mediation model (Figure 1), after controlling for participants' gender (females coded as 0, males coded as 1; $\beta = -0.17$; $p = 0.001$), age ($\beta = -0.004$; $p = 0.06$, ns), marital status (single coded as 0, in a relationship coded as 1; $\beta = 0.02$; $p = 0.66$, ns), living alone during the quarantine (no coded as 0, yes coded as 1; $\beta = -0.04$; $p = 0.68$, ns), and hours per day spent on social media ($\beta = 0.06$; $p < 0.001$), it confirmed the direct predictive effect of perceived loneliness on anxiety ($\beta = 0.37$; $p < 0.001$) and on excessive social media use ($\beta = 0.34$; $p < 0.001$), which in turn directly predicted anxiety ($\beta = 0.17$; $p < 0.001$). The total effect of perceived loneliness on anxiety was significant ($\beta = 0.43$; $p < 0.001$) and the bias-corrected bootstrapping mediation test indicated that loneliness predicted anxiety via excessive social media use ($\beta = 0.06$; bootstrap 95%CI [0.03, 0.09]; $p < 0.001$). The Sobel test showed that this model was

TABLE 1 | Means, standard deviations, and comparisons between male/female groups and young adult/adult groups.

	Total sample	Gender			Age		
	<i>M (SD)</i>	Males [<i>M (SD)</i>]	Females [<i>M (SD)</i>]	<i>F</i> _(1, 713)	Young adults [<i>M (SD)</i>]	Adults [<i>M (SD)</i>]	<i>F</i> _(1, 713)
Hours/day on social media	3.30 (1.47)	3.13 (1.51)	3.37 (1.45)	3.93*	3.51 (1.46)	2.80 (1.38)	31.45***
Loneliness	1.9 (0.58)	1.96 (0.53)	1.88 (0.60)	4.76*	1.96 (0.58)	1.76 (0.54)	9.71**
Anxiety	0.69 (0.67)	0.59 (0.60)	0.73 (0.69)	4.01*	0.76 (0.69)	0.52 (0.56)	13.01***
Excessive social media use	2.1 (0.81)	2.12 (0.86)	2.08 (0.79)	0.03 ^{ns}	2.16 (0.80)	1.94 (0.81)	10.51**

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

TABLE 2 | Bivariate correlations between all variables estimated with 1,000 bootstrap sample.

	1	2	3	4	5	6	7	8
1. Gender	–							
2. Age	0.000	–						
3. Marital status	0.080*	–0.276***	–					
4. Living alone during COVID-19	0.000	0.129**	0.137***	–				
5. Hours/day on social media	–0.073	–0.220***	0.120**	0.058	–			
6. Loneliness	0.061	–0.156***	0.184***	0.082*	0.090*	–		
7. Anxiety	–0.096**	–0.162***	0.108**	0.014	0.191***	0.397***	–	
8. Excessive social media use	0.022	–0.119**	0.076*	–0.054	0.338***	0.276***	0.331***	–

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

significant ($Z = 4.52$; $SE = 0.01$; $p < 0.001$), and it explained 23% of the total variance of anxiety (Table 3).

DISCUSSION

As many recent studies on the cognitive and emotional effects of COVID-19 pandemic have suggested (2, 4, 6–13, 20), the COVID-19 emergency presents many risks to individuals' mental health. Fear of contamination has led to physical isolation as a global response, impacting on the individual responses to the health crisis (99). This isolation has probably reinforced subjective feelings of loneliness in both older and younger people (1, 5), likely strengthening the individuals' need to be part of virtual communities. In fact, the participants' preference for the use of specific social media and apps for instant messaging was in line with previous findings (100), but in our study people declared they spent more time using social media than before the forced isolation.

In the last several months, social media use has been highly recommended to obtain health and safety information and maintain social contacts in order to face the pandemic's isolation (53). Likely as a result of the distressing situation, social media use has been suggested as a temporary means of recovery from distress and as a coping strategy—which needs to be carefully managed—for facing loneliness and negative emotions (54). In this regard, social media and virtual communities allow users to interact with other people, reinforce relationships, disseminate contents, share common interests, experiences, and emotions [e.g., (101–105)], and also improve their engagement in digital platforms (103, 106, 107). However, social media involvement risks to become excessive or dysfunctional, by triggering a behavior–reward feedback loop (84, 108–110) that reinforces negative moods and supports a vicious use of social media.

In fact, in the compensatory model of problematic Internet-related activities, it is postulated that the reactions to negative life circumstances might lead to excessive Internet use and

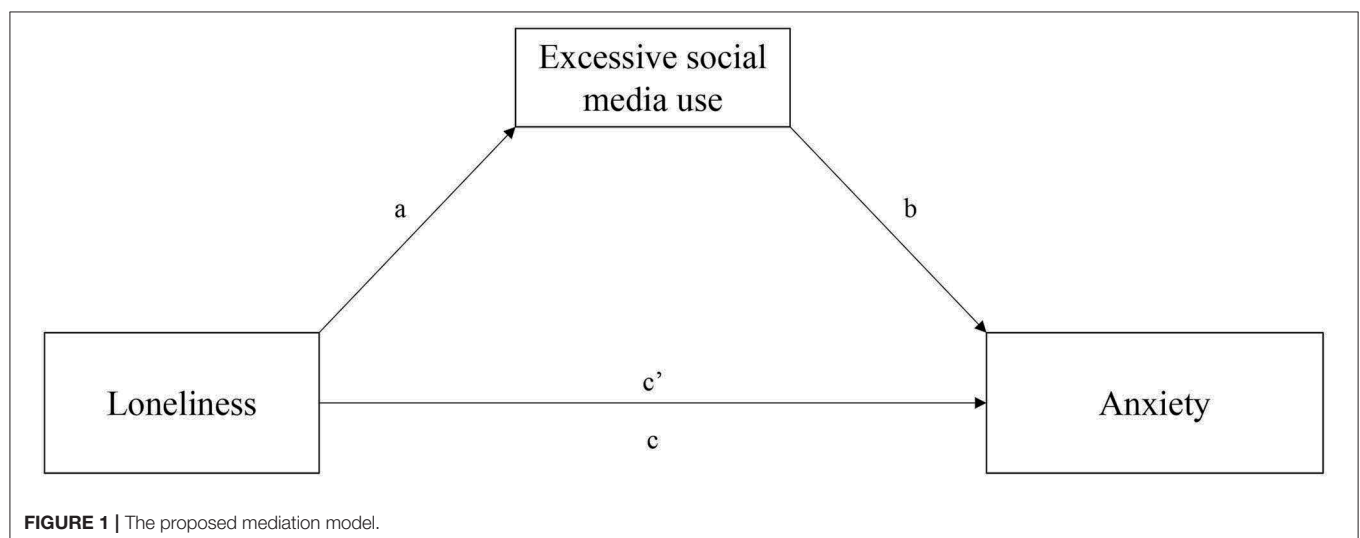
addictive-like symptoms (92); yet, in such theoretical framework, these symptoms might represent the temporary outcome of a maladaptive and transitory solution to a distressing situation rather than an actual psychopathological condition. This consideration also explains our preference for terms, such as “excessive social media use” and “addictive-like social media use” when discussing a disproportionate engagement in social network, rather than the more common (but often incorrect on the theoretical and clinical level) “social media addiction”: the specific circumstance and reasons for an excessive media use should be carefully examined and addressed before applying the “addiction” label to it (111), and individuals should not be generally and indiscriminately pathologized for their social media use (112), especially during a pandemic isolation (113).

In this sample of Italian adults, the tested mediation model suggested that perceived loneliness during COVID-19 pandemic was positively associated, both directly and indirectly, with anxiety. Furthermore, increased feelings of loneliness and isolation predicted high levels of both anxiety and excessive social media use, in addition, when we controlled for excessive social media use, the predictive effect of loneliness on anxiety

TABLE 3 | The effect of perceived loneliness on anxiety with mediating effect of excessive social media use.

	Model 1 (anxiety)		Model 2 (excessive social media use)		Model 3 (anxiety)	
	β	t	β	t	β	t
Loneliness	0.37	9.23***	0.34	6.96***	0.43	10.8***
Excessive social media use					0.17	5.72***
R^2	0.23***					
$F_{(7, 707)}$	30.96					

*** $p < 0.001$.



further increased. Likely, the facilitated and prolonged access to social media has been a common individual response to stay connected during the quarantine, thus it is possible that people increasingly engaged in social media in an attempt to face their perceived isolation, acting as problematic users in this circumstance. However, this solution may reflect a fear of invisibility and inaction due to the pandemic (3) that has proved to be unsuccessful for lonelier people, whose feelings of anxiety increased. Likely, even though online social interactions can act as a temporary useful solution that allows individuals to keep in touch with other people, thus fostering social support (54) and allowing individuals to feel less alone (1), it seems that in the medium to long run, online social contacts cannot substitute offline social interactions in reducing feelings of loneliness and anxiety (84). Indeed, research shows that online social interactions tend to enhance well-being, social belonging, and relationship quality when used in combination with offline social interactions (85, 114, 115). Thus, in line with theory (116), online interactions do not provide a definitive solution to relieve users from their subjective sense of isolation during a prolonged absence of further social contacts outside the household. Overall, our findings suggest that exclusive and excessive use of social media has likely acted as a coping strategy for individuals' feelings of loneliness. However, in some cases, this may represent a maladaptive strategy that might foster a dysfunctional feedback loop reinforcing lonely individuals' anxiety in the specific pandemic circumstance. Accordingly, problematic social media use has already been evidenced as a dysfunctional emotional-regulation strategy (117–119), although it is frequently used to control mood (120–124). Thus, despite this excessive social media use denoting individuals' efforts to face their sense of loneliness and isolation, it might also foster more negative outcomes if forced by the situation and prolonged in time.

Evidence also showed that the increase in negative feelings was stronger among women and younger participants when examining the effects of sociodemographic variables in the mediation models, which is in line with vast amounts of literature suggesting increased internalizing symptoms in females (125), even during the pandemic crisis (12) and greater difficulties with emotional regulation among younger people (126). Moreover, according to literature, in this sample, women and younger adults seem to not only be more engaged in online social connections (71, 85) but also more exposed to negative moods. Finally, they seem to use social media more dysfunctionally for controlling their feelings of loneliness, and this might have reinforced their feelings of anxiety.

This study has some limitations that need to be addressed. First, the cross-sectional design limited the ability to formally test causative effects. Second, despite the participants coming from the entire Italian peninsula, the different geographic areas of Italy have been differently affected by the COVID-19-related health crisis, limiting the generalizability of results. Moreover, the present study explored only a small number of variables in relation to the complexity of the relationship among feelings of loneliness, excessive social media use, and anxiety during the COVID-19 pandemic. In particular, information about the

participants' general health status during the pandemic and the presence of direct or indirect contact with the virus has not been collected in our study. Furthermore, it has been demonstrated that individuals' temperament and characteristics in the psychological response to the ongoing pandemic provide insights into developing tailored intervention strategies and need to be better investigated (99). Future research may examine the role of such variables to improve our understanding of individuals' social media use during the pandemic and to further identify specific groups of people that might be more vulnerable to problematic use. Finally, this study evaluated general use of social media during the pandemic, including apps for instant messaging. Further research could explore whether the use of specific social media is related with an excessive involvement and addictive-like symptoms.

These limitations notwithstanding, our findings suggest that excessive social media use was associated with increased feelings of loneliness and anxiety during the COVID-19 pandemic. The current pandemic is not only changing priorities for the general population but it is also challenging the agenda of health professionals, including that of psychiatrists and other mental health professionals. Accordingly, clinical interventions with people who will continue to display excessive social media use after the pandemic resolution might specifically address their feelings of loneliness that may prompt such dysfunctional use and foster anxiety. Moreover, clinicians might successfully orient problem-focused coping styles toward helping people facing loneliness (127). Additionally, preventative actions need to be taken to improve literacy about media consumption among the general population, to help individuals to adequately use social media, and to avoid the risks associated with excessive social media use during pandemics.

Furthermore, mental health clinicians need to be directly involved in the management of the crisis and post-crisis also as part of policy task forces (20), since the ongoing as well as the lasting effects of the pandemic on individuals' behaviors need to be accounted for. Indeed, lonely people are already at risk of preferring online social interactions (78, 85), which displace time spent in offline social activities. The global epidemic has probably exponentially enlarged the number of lonely individuals, suggesting that their long-lasting use of social platforms must be addressed. The risky impacts of over or even exclusive involvement in online activities on people restarting their offline lives and relationships after the COVID-19 emergency deserves particular attention, considering the potential danger of prolonged psychological and socioemotional withdrawal when the pandemic ends. For this reason, longitudinal designs are greatly needed to analyze the pandemic's effects on social media use in different populations more in greater depth, and the differences and similarities between different cultural contexts should be explored. Yet, the findings of this study already suggest that clinicians should carefully assess and eventually treat feelings of loneliness and internalizing symptoms, such as fear and anxiety due to the COVID-19 in the post-pandemic world (12) and support the view that boosting literacy about social media use across the population could be critical to promote adaptive alternatives for

socialization without fostering maladaptive involvements in the digital world.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethical Committee of Psychological Research Department of Humanities—University of Naples Federico II.

The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

VB designed the study, led the literature research, and wrote the manuscript. FG contributed to data collection and led the statistical analysis. AM conceptually contributed to the development of the work and edited the manuscript. AS critically revised the whole work for important intellectual content and edited the manuscript. All authors read and approved the final version of the paper.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Anxiety Level of University Students During COVID-19 in Saudi Arabia

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OPEN ACCESS

Edited by:

Roger McIntyre,
University of Toronto, Canada

Reviewed by:

Muhammad Omair Husain,
The University of Manchester,
United Kingdom
Leonardo Emberti Gialloreti,
University of Rome Tor Vergata, Italy

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 14 July 2020

Accepted: 12 November 2020

Published: 11 December 2020

Citation:

Khoshaim HB, Al-Sukayt A, Chinna K, Nurunnabi M, Sundarasan S, Kamaludin K, Baloch GM and Hossain SFA (2020) Anxiety Level of University Students During COVID-19 in Saudi Arabia.
Front. Psychiatry 11:579750.
doi: 10.3389/fpsy.2020.579750

COVID-19 is the worst pandemic of this millennium, and it is considered to be the “public enemy number one.” This catastrophe has changed the way we live in the blink of an eye. Not only has it threatened our existence and health status, but the damage associated with it could equally affect our economic, social, and educational systems. The focus of this study was on the anxiety level of university students during the COVID-19 pandemic in Saudi Arabia. The study was conducted between March and June 2020. A questionnaire was administered online, and 400 completed questionnaires were returned. In this study, the Zung self-rating anxiety scale was used to determine the anxiety levels among the respondents. The results indicated that about 35% of the students experienced moderate to extreme levels of anxiety. Anxiety was highly associated with age, sex, and level of education. These findings can enlighten government agencies and policy makers on the importance of making prompt, effective decisions to address students’ anxiety during the COVID-19 pandemic. Researchers are encouraged to focus their future studies on how to develop strategies to boost students’ resilience and enhance their adaptability skills for similar disasters in the future.

Keywords: pandemic, university students, anxiety, Saudi Arabia, COVID-19, women anxiety

INTRODUCTION

The COVID-19 disease is the worst pandemic outbreak in the new millennium. Caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the first case was detected in December 2019 in Wuhan, China. Since then, the disease has spread to almost every part of the globe. The spread of the disease was so fast that on January 30, 2020, the WHO declared COVID-19 to be a *Public Health Emergency of International Concern*. As of April 2020, almost 3 million positive cases were confirmed worldwide, with about 200,000 fatalities (1). In view of the high number of secondary cases arising from one primary case and the population being largely susceptible to infection, the WHO declared COVID-19 disease as a pandemic on March 12, 2020 (2). To control the spread of the disease, China and many other countries imposed lockdowns, either nationwide or in places severely affected by the virus. Educational institutions, financial institutions, centers of economic activities, and amusement centers closed indefinitely (2, 3). It is estimated that as of April 2020, more than 300 million students were affected by COVID-19 globally (4). Worldwide, many schools and colleges either closed or resorted to distance learning. Public gathering and celebrations were prohibited. People with severe infection were treated in hospitals, and the less

severe patients were placed in quarantine centers. These measures are similar to those that have previously proven effective during the H1N1 pandemic as reported by Sakaguchi et al. (5) and during SARS as reported by Ries (6).

In the Kingdom of Saudi Arabia (KSA), the Ministry of Health (MOH) announced the first COVID-19 case on March 2, 2020, and by the end of the month, 154 new COVID-19 cases were reported (7). Anticipating widespread infection, government agencies swiftly implemented several control measures to combat the spread of the virus. In view of mass gatherings, Umrah in Mecca and visitations to the Prophet's Mosque in Madina were suspended immediately, and all the mosques in the country closed temporarily (8–10). Quarantining of infected people and practicing social distancing became the norm. Universities and schools were closed, switching to virtual classes, to ensure uninterrupted teaching. Students were expected to continue studies from their place of residence. Despite the awareness campaigns and precautionary measures taken by the government, the number of cases continued to increase. Within 3 months, the confirmed cases escalated to 98,869, out of which 71,791 recovered, and 642 died (11).

In addition to the risk of infection and possible death, an epidemic also exerts tremendous psychological pressure on people worldwide (12–17). Several studies have discussed the short- and long-term effects of epidemics on the social and psychological well-being in the population (18–20). Those who were tested positive for a disease continue to be stigmatized and suffer from seclusion in their own society even after they have recovered (19, 21). Those quarantined experienced psychological stressors including “longer quarantine duration, infection fears, frustration, limited supplies, insufficient communication, financial loss, and stigma” [21, p. 1]. Brooks et al. (22) expect that COVID-19 will result in drastic post-traumatic stress symptoms, confusion, and anger.

Moreover, anxiety level among college-level students is already a public health concern. In fact, several previous researches have examined students' anxiety, depression, and stress and have discussed factors that might affect students' mental health (23–32). Looking at students in the Kingdom of Saudi Arabia, Amr et al. (27) reported a 20% level of anxiety among college-level Saudi students, while Al-Gelban (26) argued that 14.3% of secondary school students experience anxiety. In contrast, Al-Gelban (25) and Al-Gelban et al. (33) reported a much higher anxiety level (48.9 and 66.2%, respectively) among high school students. Given that the spread of COVID-19 and the switch to virtual learning are unprecedented and unexpected experiences in Saudi Arabia, we can expect such circumstances to be associated with major psychological challenges for the students. The fear of getting infected or losing loved ones to the disease while having to rapidly adjust to the new teaching and assessment procedures would have had a tremendous pressure on the students. At this time, besides testing, planning, and implementing new teaching and learning environments, educational institutions need to assess the students' psychological well-being so that appropriate measures can be taken to help students cope with unprecedented changes. The purpose of this

study is to assess the anxiety status of students in Saudi Arabia during COVID-19 pandemic.

RESEARCH METHODOLOGY

Participants, Procedures, and Timeline of Survey

This study examined the anxiety level among university students in Saudi Arabia, specifically in Riyadh, at the time of the COVID-19 pandemic. Riyadh is the capital of Saudi Arabia and one of the largest cities in the Kingdom, with an area of 1,798 km² and a population estimated at 7,231,447 (34). The sample was chosen from one private university. The total number of undergraduate students of both genders currently enrolled in this university is 5,057 students, comprising 3,085 female and 1,972 male students. An online questionnaire created in Google Forms was distributed via email to all undergraduate students at this university. Data were collected from April 20, 2020, to June 6, 2020. Although this period is not ideal as it is at the end of the academic year, the authors preferred to address this concern while the COVID-19 concern is at its maximum instead of waiting until the end of summer. The students were briefed on the purpose, and anonymity and confidentiality of their responses. Permission to conduct this study was obtained from the Institutional Review Board (IRB) of the university.

Research Instrument

In this study, the anxiety level was assessed using Zung's self-rating anxiety questionnaire, a validated 20-item self-report instrument (35) with reported Cronbach's alpha = 0.897 and internal correlation = 0.913 (36). The instrument employs a four-point Likert scale where: “1 = Never or very rare,” “2 = Sometimes,” “3 = Often,” and “4 = Very Often or always.” Questions 1–5 characterize the emotional pointers of anxiety, whereas questions 6–20 signify the physical symptoms of anxiety. For each respondent, the sum of the scores for 20 items ranges from 20 to 80. The sum of scores are then converted to an “Anxiety Index” with values ranging from 25 to 100. Following the recommendations from Zung (37) and Dunstan and Scott (38), an Anxiety Index <45 indicates “Anxiety within normal range,” a value in the range of 45–59 indicates “Mild to moderate anxiety,” a value in the range of 60–74 indicates “Marked to severe anxiety,” and values ≥75 indicates “Most extreme anxiety.” Apart from Zung's self-rating anxiety scale, demographic information such as age, gender, year of study, field of study, and living arrangements during the pandemic were also recorded. Moreover, the participants had the chance to reflect on their feelings through open-ended sections. Although Arabic is the mother tongue of the Saudi population, English is the language of instruction at this university. Hence, the instrument was used in its original language and was not translated.

Data Analysis

The IBM SPSS version 22 software (39) was used in data analysis. Chi-square and ordinal regression procedures were used to determine the factors associated with levels of anxiety. All the

TABLE 1 | Demographic characteristics of the respondents.

Variable	Frequency	Percentage
Gender		
Female	301	75.2%
Male	99	24.8%
Age		
≤18 years	15	3.8%
19–25 years	374	93.5%
≥26	11	2.8%
College		
Business Administration	131	32.8%
Computing and IS	73	18.2%
Engineering	65	16.2%
Humanities	16	4.0%
Law	69	17.2%
Preparatory year program	46	11.5%
Level of study		
Preparatory year program	79	19.8%
Undergraduate	321	80.2%
Year of study		
Year 1	127	31.8%
Year 2	72	18.0%
Year 3	74	18.5%
Year 4	72	18.0%
Year 5 and above	55	13.8%
Current accommodation		
Family home	359	89.8%
Rented premises	41	10.2%
Currently staying with		
Family/relatives	377	94.2%
Alone	23	5.8%

variables that were significant at 0.25 level (40) in the chi-square tests were tested in ordinal logistic regression analysis.

Ethical Clearance

Permission to conduct this study was obtained from the Institutional Review Board (IRB) of the university.

RESULTS

The aim of this study was to examine the anxiety level of university students in Saudi Arabia during the COVID-19 pandemic.

Demographic Characteristics

The questionnaire was sent to 5,057 undergraduate students, which comprise the population of this university at that time. A total of 400 responses were received, which represents an 8% response rate. Although this is a low response rate, it might be because the questionnaire was sent at the end of the semester and the beginning of final exams. The demographic characteristics of the respondents are shown in **Table 1**. Out of

TABLE 2 | Anxiety levels based on Zung's classification.

Anxiety	Frequency	Percentage	Anxiety	Frequency	Percentage
Normal	262	65.5%	Normal	262	65.5%
Minimal to moderate	86	21.5%	Minimal to moderate	86	21.5%
Marked to severe	35	8.8%	Severe to extreme	52	13.0%
Most extreme	17	4.3%			

the 400 respondents, 75.25% (301) were females, and 24.75% (99) were males and most of the respondents (93.5%). The skewed response rate toward females could be due to the fact that the females represent around 60% (3,085 female students) of the population of the university. Most of the respondents (93.5%) were in the age group of 19–25 years. Regarding their field of study, about one-third of the students were from the College of Business Administration, and around one-sixth each were from the College of Law and the College of Computer and Information Sciences. Most of the students (80%) were undergraduates, and 20% were in the Preparatory Year Program (PYP), which is a compulsory 1-year program for all high school graduates. In terms of accommodation, 89.8% (359) were living at homes owned by their parents, and only around 10% were living at rented facilities. Moreover, 94.2% of the students were staying with their families at the time of the pandemic.

Levels of Anxiety

Among the respondents, 21.5% (86), 8.8% (35), and 4.3% (17) experienced “minimal to moderate,” “marked to severe,” and “most extreme” levels of anxiety, respectively. For further analysis, respondents in the “marked to severe” and “most extreme” anxiety category were grouped together as “severe to extreme” level of anxiety. A summary of the results is shown in **Table 2**.

Factors Associated With College Students' Anxiety During the Epidemic Results From Univariate Analysis

In the univariate analyses, chi-square tests were used to determine the associations between students' demographic variables and anxiety levels. The results are shown in **Table 3**. Among the demographic variables, gender, age, year of study, and living arrangement were significant at a 0.25 level.

Results From Ordinal Regression Analysis

The variables of gender, age, year of study, and living arrangement that were significant at the 0.25 level in the univariate analyses were further tested using ordinal logistic regression analysis. In this analysis, only gender and year of study were significant (**Table 4**). Interestingly, female students were more prone to higher levels of anxiety compared to males (OR = 1.963, 95% CI = 1.160, 3.322, $P = 0.012$). Students in their fourth year were more anxious compared to students in their fifth year or final year (OR = 2.440, 95% CI = 1.150, 5.179, $P = 0.020$).

TABLE 3 | Results of univariate analyses.

Variable	Normal	Minimal to moderate	Severe to extreme	Chi-square	p-value
Gender				7.465	0.024
Female	186 (61.8%)	71 (23.6%)	44 (14.6%)		
Male	76 (76.8%)	15 (15.2%)	8 (8.1%)		
Age				3.277	0.194
≤18	7 (46.7%)	4 (26.7%)	4 (26.7%)		
≥19	255 (96.2%)	82 (21.3%)	48 (12.5%)		
College				6.862	0.738
Business administration	90 (68.7%)	28 (21.4%)	13 (9.9%)		
Computing and IS	49 (67.1%)	15 (20.5%)	2 (12.3%)		
Engineering	38 (58.5%)	17 (26.2%)	10 (15.4%)		
Humanities	10 (62.5%)	5 (31.2%)	1 (6.2%)		
Law	43 (62.3%)	15 (21.7%)	11 (15.9%)		
Preparatory year program	32 (69.6%)	6 (13.0%)	8 (17.4%)		
Level of study				0.918	0.632
PYP	55 (69.6%)	14 (17.7%)	10 (12.7%)		
Undergraduate	207 (64.5%)	72 (22.4%)	42 (13.1%)		
Year of study				12.569	0.129
Year 1	86 (67.7%)	22 (17.3%)	19 (15.0%)		
Year 2	50 (69.4%)	17 (23.6%)	5 (6.9%)		
Year 3	48 (64.9%)	16 (21.6%)	10 (13.5%)		
Year 4	37 (51.4%)	23 (31.9%)	12 (16.7%)		
Year 5 and above	41 (74.5%)	6 (14.5%)	6 (10.9%)		
Accommodation				0.630	0.730
Family home	233 (64.9%)	79 (22.0%)	47 (13.1%)		
Rented premises	29 (70.7%)	7 (17.1%)	5 (12.2%)		
Living arrangement				3.488	0.175
Alone	14 (60.9%)	8 (34.8%)	1 (4.3%)		
Family/Relatives	248 (645.8%)	78 (50.7%)	51 (13.5%)		

Open-Ended Questions

In the Google form, the students were asked open-ended questions requiring them to reflect on their feelings and concerns regarding the COVID-19 pandemic. Some of the positive comments from the students were:

"Personally, I got a lot more work done and a lot more sleep than usual."

"It is great and much better than regular classes."

"Everything will be OK."

"I'm using my time wisely during covid-19."

"The freedom of learning from home is very appealing to me."

Regarding the question on concerns, a majority of the concerns reported were financial in nature, such as about their ability to pay for the next semester, the possibility of increased tuition fees, and the loss of income for the provider of their family. Some students wanted the university to decrease the fee for this semester to cope with the challenges. Some of the financial concerns as expressed by the students were:

TABLE 4 | Results from ordinal multivariate analysis.

Parameter	B	SE	p-value	OR _{adj} (95% CI)
Gender				
Female	0.674	0.269	0.012	1.963 (1.160, 3.322)
Male	ref			1
Age				
≤18 years	0.870	0.530	0.101	2.386 (0.845, 6.739)
≥19 years	ref			1
Year of study				
Year 1	0.155	0.3723	0.678	1.167 (0.563, 2.422)
Year 2	0.139	0.4020	0.729	1.149 (0.523, 2.537)
Year 3	0.394	0.3927	0.316	1.483 (0.687, 3.201)
Year 4	0.892	0.3840	0.020	2.440 (1.150, 5.179)
Year 5 and above	ref			1
Living arrangement				
Alone	−0.116	0.431	0.780	0.891 (0.382, 2.074)
Family/Relatives	ref			1

B, regression coefficient; SE, standard error; OR, odds ratio; CI, confidence interval.

"My family business got affected by the coronavirus, and I'm having troubles in this regard."

"I'm afraid that [the college] might increase the fees to the point where I can't afford to finish my studies."

In addition to financial concerns, the students were also concerned about the uncertainties regarding assessments and how they would be graded.

DISCUSSION

College students around the world suffer from psychological morbidity, particularly depression and anxiety, due to concerns about the future and academic pressure such as managing stressful tasks and assignments and pursuit to improve their academic performance (24, 29, 30, 32, 41–44). A variety of studies have shown that college students in Saudi Arabia share the same symptoms of anxiety and stress and recorded a prevalence of depression and anxiety ranging from 14 to 50% [e.g., (25–27)]. On the other hand, Inam (45) reported around 66 and 44% level of anxiety and depression in females and males, respectively, when looking at Saudi medical school students, while Al-Gelban et al. (33) argued that 66% of the female high school students in Saudi Arabia experienced some level of anxiety. Similarly, a study by Bahhawi et al. (28) showed that students experienced some symptoms of depression (53.6%) and anxiety (65.7%) among the samples. In addition, Al Salman et al. (46) examined female secondary school students during the academic year 2018–2019 and reported around 35% level of moderate anxiety and 10% of severe anxiety.

The presence of COVID-19 is an additional factor for students to be stressed and anxious about (15). Several studies have addressed psychological well-being during the COVID-19 pandemic [e.g., (15, 47–49)] and other past epidemics [e.g., (6, 50–52)], either on students [e.g., (47)] or others

[e.g., (21, 53–55)], who postulated that psychological health during pandemics must be addressed. Based on the findings of the current study, around 35% of the students experienced some level of anxiety, with 13% having severe to extreme levels. This is consistent with the research done by Alyami et al. (47), which looked at the anxiety level of the Saudi society during COVID-19 and reported 26% level of anxiety. Moreover, it is more or less similar to what was reported about students in Saudi Arabia before COVID-19 (25, 27, 28, 33). This indicates that the level of anxiety was almost consistent with pre-pandemic status. In fact, Bahhawi et al. (28) reported a higher level of anxiety. Looking outside Saudi Arabia, Cao et al. (48) found that 0.9% of college students experienced severe anxiety during COVID-19, while around 24% experienced mild to moderate levels, which presents a low level of anxiety compared to previous literature on college students in general. However, considering that Cao et al. (48) study was conducted on college students in China at the early stage of COVID-19, we can see that the lack of the full picture of this pandemic might have contributed to these results.

The argument that females are more vulnerable than men to disasters is not a new topic (56). The fact that the female students experienced higher levels of anxiety is also not surprising. Previous studies show that college female students report more stress than male students in general (28, 45, 57). In fact, comparing the two studies by Al-Gelban (25) and Al-Gelban (26) shows that using the same instrument on male and female students provided different results. While only 59.4% of the male students had one of three symptoms, 73.4% of female students had the same. We must keep in mind that the two studies are 2 years apart. Even at the post-graduate level, Almalik et al. (58) argued that female students have a significantly higher anxiety level than male students. Moreover, Huang et al. (59) argue that Chinese females experience more anxiety than males during COVID-19.

One surprising finding was the association between anxiety and the level of study; students in their fourth year were more anxious compared to students in their fifth or final year. However, one might expect that as a student progresses in his or her level of study, any consequences brought about by the pandemic would be nearly permanent and unfixable, and so fifth-year students might be more anxious than fourth-year students. Nevertheless, the fact that fifth-year students had less anxiety than their colleagues in the fourth year is also justifiable. These students were either (1) in their cooperative training program (co-op), so their graduation or academic attainment is not expected to be influenced by the virtual education decision as most of the co-op companies have arranged for an online working/training environment, or (2) in their last semester of courses; in this case, given the implementation of a special grading scheme imposed by the Ministry of Education in Saudi Arabia, a low grade point average for a student would not have an impact, regardless of the final results. Thus, these students were somehow more relaxed, at least with regard to their educational future. This explanation is supported by

the reflections from some of the fourth-year respondents, such as:

“My top concern right now is whether we will be returning to the university for the first semester. It is my last semester before coop and all my courses have labs which will be near impossible to achieve in online classes.”

“I’m nervous about registering the next semester and might not have the courses that I planned to take to graduate.”

CONCLUSIONS, IMPLICATIONS, AND FUTURE RESEARCH

COVID-19 has been a catastrophic experience; in the blink of an eye, this dreadful pandemic abruptly changed the way we live. As reported in the literature, pandemics are expected to have undesirable consequences not only in terms of health but also on economic, political, and educational systems (60, 61). Hence, it is imperative that the world cooperates to fight this pandemic. In that, educational institutions are advised to establish pre-outbreak policies and procedures to deal with epidemics (62).

This study is part of a more comprehensive project that aims to address the psychological well-being of university students in several parts of the world during COVID-19. The results of this study give valuable insights into the psychological status of students at a crucial time, and this, of course, has its own merit. However, it is equally crucial that future researches focus on and suggest solutions to address any effects associated with pandemics. It is important to identify appropriate strategies that could help students not only cope with adverse effects of the current pandemics but that can also enhance students’ resilience to similar disasters in the future. Parents, educators, and the society as a whole should identify ways to enhance students’ adaptability skills that will enable them to cope in such situations.

Moreover, future research may utilize a mixed methodology approach or large-scale comparative studies with collaborations with other countries to look at potential coping strategies that have been proven to be effective in past pandemics or during the current one (63). This might guide policy makers to develop risk management protocols as part of their policy for the future to contain future pandemics (64). Most importantly, as much as we are convinced that COVID-19 is the current enemy of humanity, we must be aware of associated impact and be able to respond effectively to all consequences.

LIMITATIONS

This study aimed to elucidate the anxiety level of Saudi college-level students at the time of COVID-19. However, due to time constraints and to avoid a long protocol of obtaining IRB from several universities, this research only focused on one university. Although this is a small-sample study, the results can be enlightening especially since such a pandemic is a novel experience for the Saudi population, and so any data will be

welcomed. The results can, hence, guide future research on COVID-19 or other epidemics.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Research and Initiative Center at Prince Sultan University. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

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AUTHOR CONTRIBUTIONS

HK, AA-S, and KK were responsible about data collection process. Data statistics was completed mainly by KC. The introduction, discussion, and conclusion parts were completed by all authors including HK, AA-S, KC, MN, SS, KK, GB, and SH. All authors contributed to the article and approved the submitted version.

FUNDING

The researchers would like to acknowledge Prince Sultan University for its support for this project through the PSU COVID-19 Emergency Research Program (Grant ID: COVID-19-CBA-2020-39).

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Insomnia in the Italian Population During Covid-19 Outbreak: A Snapshot on One Major Risk Factor for Depression and Anxiety

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OPEN ACCESS

Edited by:

Lisa Jones,
University of Worcester,
United Kingdom

Reviewed by:

Katie J. S. Lewis,
Cardiff University, United Kingdom
Nicola Barclay,
University of Oxford, United Kingdom

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 10 July 2020

Accepted: 25 November 2020

Published: 15 December 2020

Citation:

Bacaro V, Chiabudini M, Buonanno C,
De Bartolo P, Riemann D, Mancini F
and Baglioni C (2020) Insomnia in the
Italian Population During Covid-19
Outbreak: A Snapshot on One Major
Risk Factor for Depression and
Anxiety. *Front. Psychiatry* 11:579107.
doi: 10.3389/fpsy.2020.579107

Objectives: One of the largest clusters of Covid-19 infections was observed in Italy. The population was forced to home confinement, exposing individuals to increased risk for insomnia, which is, in turn, associated with depression and anxiety. Through a cross-sectional online survey targeting all Italian adult population (≥ 18 yrs), insomnia prevalence and its interactions with relevant factors were investigated.

Methods: The survey was distributed from 1st April to 4th May 2020. We collected information on insomnia severity, depression, anxiety, sleep hygiene behaviors, dysfunctional beliefs about sleep, circadian preference, emotion regulation, cognitive flexibility, perceived stress, health habits, self-report of mental disorders, and variables related to individual difference in life changes due to the pandemic's outbreak.

Results: The final sample comprised 1,989 persons (38.4 ± 12.8 yrs). Prevalence of clinical insomnia was 18.6%. Results from multivariable linear regression showed that insomnia severity was associated with poor sleep hygiene behaviors [$\beta = 0.11$, 95% CI (0.07–0.14)]; dysfunctional beliefs about sleep [$\beta = 0.09$, 95% CI (0.08–0.11)]; self-reported mental disorder [$\beta = 2.51$, 95% CI (1.8–3.1)]; anxiety [$\beta = 0.33$, 95% CI (0.25–0.42)]; and depression [$\beta = 0.24$, 95% CI (0.16–0.32)] symptoms.

Conclusion: An alarming high prevalence of clinical insomnia was observed. Results suggest that clinical attention should be devoted to problems of insomnia in the Italian population with respect to both prevention and treatment.

Keywords: insomnia, sleep, Italian, COVID-19, home confinement, depression, anxiety

INTRODUCTION

On 21st February 2020 several cases of Covid-19 disease emerged in a specific area of Lombardy in Italy. In the following days, the infection spread within the North of the country. On Monday 9th March the entire country was declared “protected area” and in the “lockdown” condition. Particularly, the following rule was established: possibility to go out only for reasons of certified necessity such as for food shopping, work needs, purchase of drugs, or other health reasons. The

lockdown was gradually released on 4th of May 2020. This represented one of the largest and most severe clusters of Covid-19 infections worldwide.

This situation exposed most individuals to unprecedented stress, alarming mental health experts for the risk of a major diffusion of psychological disorders within the population (1, 2). Sleep is a fundamental psychophysiological process for brain function and mental health [e.g., (3, 4)]. Home confinement may have played an important role in changing and negatively impacting sleep quality, thus leading to major risk factor for acute insomnia (5). Insomnia, on the other hand, is linked with increased risk for negative health outcomes (6, 7), including depression and anxiety (8, 9). The present paper focuses on insomnia in the Italian population during the lockdown, as a key vulnerability condition for mental health.

Insomnia disorder is defined as difficulties initiating or maintaining sleep, or early morning awakening associated with impaired daytime functioning, which occurs at least 3 nights a week for 3 months [DSM-5, (10)]. Insomnia is associated with reduced quality of life (11–13), increased risk for cardiovascular diseases (14) and for psychopathology, specifically for depression and anxiety (8, 9, 15, 16). Insomnia is considered a key transdiagnostic factor for mental health (3).

A task force of experts in the field (5) pointed out an alarming situation for which during the lockdown condition individuals' sleep quality was potentially challenged by several processes. This could represent a risk factor for the development of acute insomnia which can turn into chronic insomnia and finally exposing individuals to higher risk for psychopathology.

These processes could be summarized as follows:

- Demographic aspects as age and gender are identified as risk factors for insomnia, with women having increased risk compared to men and prevalence rates increasing with age [for a review see (15)].
- Individual differences in personality traits are associated to variability in resilience ability and adaptation to adverse events. Emotion regulation and cognitive flexibility seem to be relevant factors in stress response and adjustment [e.g., (17, 18)]. Gross (19) defines emotion regulation as the process by which people influence emotions they have, when they have them, and how they experience and express them. Particularly, systematic use of expressive suppression [a form of response modulation that consists in inhibiting an ongoing emotion, Gross (20)] has been often conceptualized as a maladaptive response to stressful situations and it is linked with higher risk for psychopathology (21). In turn, systematic use of cognitive reappraisal [a form of response modulation which involves changing the way one thinks about a potentially emotion eliciting event, Gross (20)] is considered a factor of resilience [e.g., (18)]. Cognitive flexibility is defined as the ability to shift between “cognitive sets” or strategies in response to changes in the environment (22). Dispositional use of expressive suppression and lower levels of cognitive flexibility have been associated to poor sleep quality [e.g., (23, 24)].

Furthermore, Stress is the most commonly studied precipitating factor of insomnia (25). Acute stressors, as home confinement and uncertainty regarding future, usually trigger acute insomnia (26).

- Healthy sleep behaviors, such as regular sleep times, use of bed for sleeping only, avoiding using electronic devices in beds; regular physical activity, healthy eating, and alcohol habits, are considered to be protective factors for sleep problems during home confinement (5).
- Individual different levels of knowledge about sleep, consequences of poor sleep, and insomnia may be associated to vulnerability to insomnia (27).

Additionally, specific life conditions could have exposed individuals to increased stress and acute insomnia. For example, de Girolamo et al. (1) identified specific subgroups at risk for mental disorders including those with health related work; individuals tested positive for the virus; relatives of persons who died in this period; individuals with current mental disorders. Further relevant subgroups might be: people with past insomnia and/or mental disorder (28); individuals living alone [(exposed to loneliness, (29))] or living in large families constricted in shared spaces; parents [(who needed to combine family and work responsibilities in home confinement, (5)); young adults living with parents [exposed to social isolation from peers, (30)]; and individuals with evening chronotype [vulnerable to acute insomnia, (31)]. Finally, as the pandemic spread differently within the country, those in the North may have experienced higher stress compared to people living in the Center and the South of Italy.

An hypothesis of how all these variables could interact is schematically represented in **Figure 1**.

The present study aims at providing a snapshot of the prevalence of insomnia disorder in the Italian population during Covid-19 pandemic and investigating its association with potential risk factors and its link with anxiety and depression symptoms.

Specifically, we aimed at evaluating:

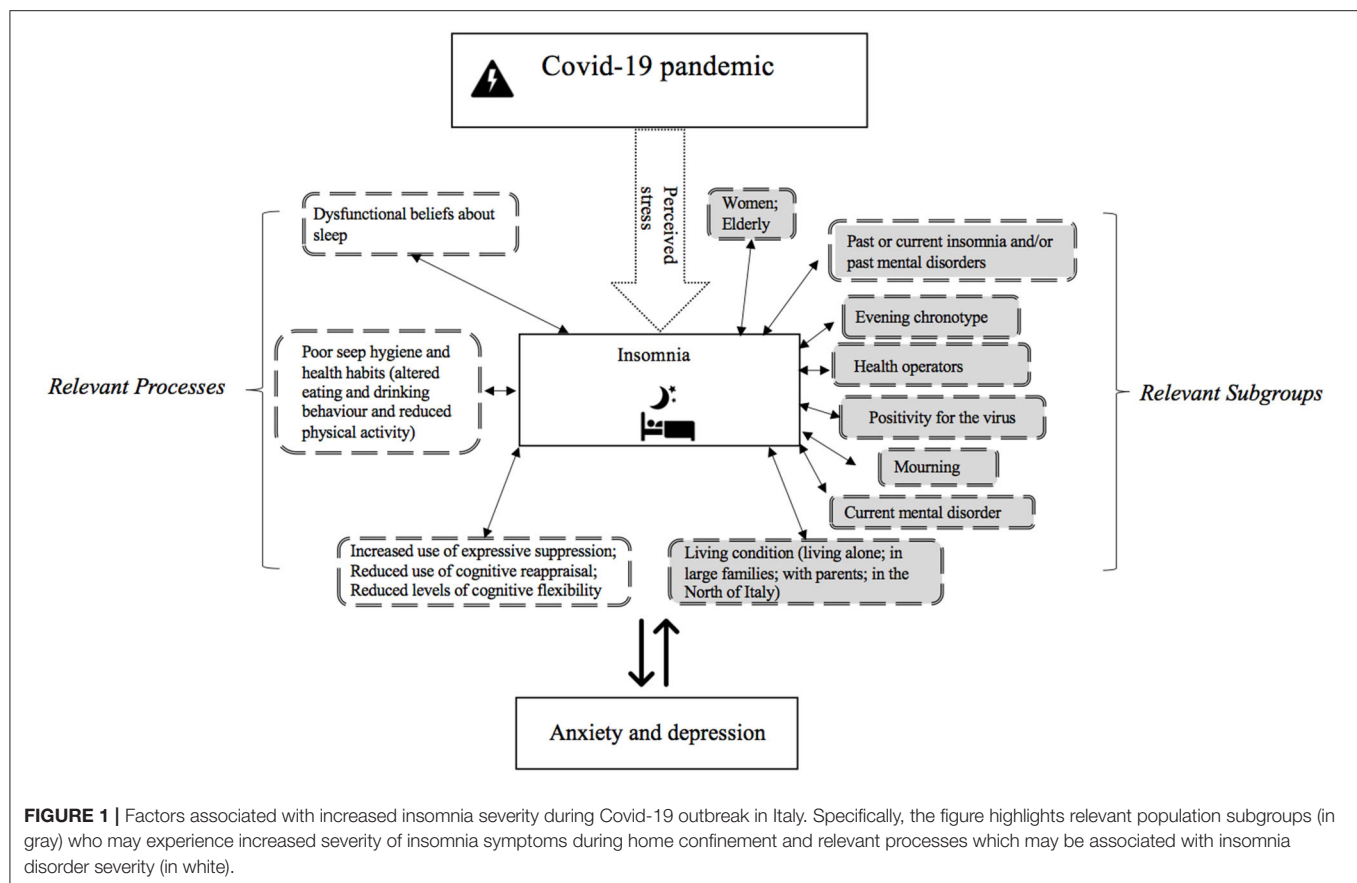
- 1) Prevalence of insomnia disorder considering age and sex.
- 2) Severity of insomnia in relevant subgroups (in gray in **Figure 1**).
- 3) Average scores of relevant processes considering insomnia status (in white in **Figure 1**).
- 4) Factors associated with insomnia severity (considering all variables listed in **Figure 1**).

METHODS

Procedure and Participants

Recruitment started on the 1st of April, about 3 weeks after the beginning of the lockdown, and was completed on the 4th of May 2020, the day in which the lockdown was gradually released.

The study was conducted in collaboration between the Department of Human Sciences of the University of Study Guglielmo Marconi of Rome (Italy), the Italian School of Specialization in Cognitive Psychotherapy (SPC, Rome,



Italy), and the Sleep Laboratory of the Department of Clinical Psychophysiology/Sleep Medicine of the Center for Mental Disorders of the University Medical Center of Freiburg (Germany).

An online survey was created on Survey Monkey platform, an anonymous database and data repository commonly used in research [e.g., (32)]. The completion of the study was voluntary and anonymous and lasted about 15–20 min. First, participants were asked to read accurately the information about the study and to fill in a written informed consent form before starting the survey. Contacts of researchers were given in the informative page for any doubt or need.

The survey was distributed in all Italian territory with different strategies of dissemination: personal contacts of researchers, sponsorship of the University of Study Guglielmo Marconi, sponsorship of the Italian Association of Psychotherapy, the mailing list of the Italian Society of Behavioral and Cognitive Therapy, an article in a major Italian daily newspaper, social networks of the Medical Center Santagostino, sponsorship of the European Cognitive Behavioral Therapy for Insomnia Academy and link on social networks (Facebook, LinkedIn, Instagram).

Inclusion criteria for participation were:

- 1) To have Italian residence and to spend the lockdown in Italy;
- 2) To have good knowledge and understanding of the Italian language;

- 3) To be 18 years old or more.

No compensation for participating in the study was provided. All procedures were performed in accordance with the 1964 Helsinki Declaration and its later amendments, and the study was approved by the Ethical Committee of the Psychological Area of the University of Study Guglielmo Marconi of Rome (Italy).

Instruments

- An *ad hoc* questionnaire was created to collect the following sociodemographic information:
 - a) General information: age; region; nationality; weight and height; number of family components; family status [living alone; parent with at least one child <13 yrs; parent(other); individuals living with parent(s); living in couple; or other; occupation (retired; student; homemaker; employee; physician/health operator (i.e., health related work); unemployed].
 - b) Information on individual difference of the pandemic impact on personal life aspects: change in work satisfaction; change in use of electronic devices; change in physical activity; change in eating habits; change in alcohol drinking habits; worry over the situation; worry to be infected; worry that a loved one gets infected; tested positive to the virus; mourning during home confinement.

- c) Information on mental health: past and current insomnia; past and current mental disorder (depression, bipolar disorder, anxiety, panic attack, post-traumatic stress disorder, anorexia, bulimic, obsessive compulsive disorder, post-partum depression, other, and specify).
- d) Information on medical health: current medical disorder; current use of medical drugs.

- Insomnia Severity Index [ISI, (33)]

Participants provided answers on a five-point Likert scale, and summing up the results of the respective seven items, ranging from 0 to 28, a total score of insomnia severity during the preceding 2 weeks could be obtained. The total score is interpreted as follows: no insomnia (0–7); subthreshold insomnia (8–14); moderate insomnia (15–21); and severe insomnia (22–28).

- Sleep Hygiene Index [SHI, (34)]

The Sleep Hygiene Index is a 13-item self-administered questionnaire which evaluates sleep hygiene behavior, such as regular sleep times, sleep environment, pre-bed routines etc. The items included on the SHI were derived from the diagnostic criteria for inadequate sleep hygiene included in the International Classification of Sleep Disorders (35). Participants were asked to indicate how frequently they engage in specific behaviors (always = 5, frequently = 4, sometimes = 3, rarely = 2, never = 1). Higher scores are indicative of poorer sleep hygiene status. Higher scores indicate less sleep hygiene behaviors. Previous studies used a score below 26 as good sleep hygiene habits, 27–34 as on average, and 35 and above as poor sleep hygiene (34).

- Morningness Eveningness Questionnaire Reduced [MEQr, (36)]

MEQr included five questions: three items requested preferred time for going to bed, getting up and the hour of the day with maximum personal efficiency. Moreover, participants also had to assess the degree of tiredness within the first half an hour after their awakening and to indicate which circadian type they thought they belonged to. The MEQr score was obtained by summing scores of each question and ranged from 4 to 25. Scores above 18 identified subjects as morning types and scores below 11 as evening types.

- Emotion Regulation Questionnaire [ERQ, (37)]

The ERQ is a 10-item self-report scale assessing two individual strategies that people adopt in order to regulate their emotions: cognitive reappraisal and expressive suppression. Participants rate how much they agree with self-descriptive statements reflecting cognitive reappraisal or expressive suppression on a 7-point Likert-type scale. Higher ERQ scores indicate more frequent use of that strategy.

- Perceived Stress Scale [PSS, (38)]

The PSS measures the perception of stress by asking respondents to rate the frequency of their thoughts and feelings related to situations occurred in the last month. It consists of 10 items rated on a five-point Likert-type scale, ranging from “Never,” coded 0, to “Very Often,” coded

4. Scores of from 1 to 10 indicates low levels of stress; 11 to 14 are average scores; scoring 15–18 are medium to high levels and 19 and above indicates high levels of perceived stress.

- Hospital Anxiety and Depression Scale [HADS, (39)]

The HADS consists of seven items rating anxiety and seven items rating depression. Each item is scored from 0 to 3. Anxiety and depression values are the sums of the corresponding item scores. Patients can be subsequently allocated to one of the three following categories for anxiety and depression, based on the individual sum scores: non-case (0–7), borderline case (8–10), and clinical case (11 and above).

- Dysfunctional Beliefs and Attitudes about Sleep [DBAS-16, (40)]

The DBAS-16 was administered to evaluate beliefs and attitudes about sleep in this study. The scoring range for each item was from 1 (at the “strongly disagree” pole) to 5 (at the “strongly agree” pole). Lower scores represent more dysfunctional beliefs.

- Cognitive Flexibility Inventory [CFI, (41)]

The CFI 20-item self-report measure is designed to assess the levels of CF evidenced by individuals engaged in cognitive behavioral thought challenging interventions. The CFI items consist of statements dealing with beliefs and feelings about behavior for which individuals could indicate their agreement or disagreement. The CFI comprises two subscales, the Alternatives and Control subscale that measure three aspects of cognitive flexibility: (a) the tendency to perceive difficult situations as controllable; (b) the ability to perceive multiple alternative explanations for life occurrences and human behavior; and (c) the ability to generate multiple alternative solutions to difficult situations. Each item is scored on a seven-point Likert scale, ranging from strongly disagree (1) to strongly agree (7). The scoring procedures specified for the CFI require reverse scoring of select items and then summing the numerical response values to obtain a total score. Higher scores on both scales are indicative of greater cognitive adaptability associated with greater CF when encountering stressful situations; lower scores are indicative of greater cognitive rigidity associated with less cognitive adaptability when encountering stressful situations.

Statistical Analysis

Data analyses were conducted from May 4th 2020, date in which the recruitment was concluded. Data analyses were discussed with and supervised by a professional biostatistician (MC) and were performed with R (Version 3.5.1.).

Two analysis populations were defined, the enrolled set which comprised all participants who fulfilled the inclusion criteria, and the main analysis set which included all participants of the enrolled set for whom all questionnaires were evaluable. Descriptive analysis of patient characteristics

TABLE 1 | Sample characteristics.

Variables		Overall	Females	Males
<i>N</i>		1,989	1,515	474
General information				
Age (Mean $\pm$ SD)		38.4 $\pm$ 12.88	37.5 $\pm$ 12.42	41.4 $\pm$ 13.85
Region <i>n</i> (%)	North	790 (39.7%)	614 (40.5%)	176 (37.1%)
	Center	709 (35.6%)	517 (34.1%)	192 (40.5%)
	South	353 (17.7%)	278 (18.3%)	75 (15.8%)
	Islands	122 (6.1%)	96 (6.3%)	26 (5.5%)
	Unknown	15 (0.8%)	10 (0.7%)	5 (1.1%)
Family status <i>n</i> (%)	Alone	263 (13.2%)	190 (12.5%)	73 (15.4%)
	With partner	537 (27.0%)	415 (27.4%)	122 (25.7%)
	With at least one child below 13 years	358 (18.0%)	276 (18.2%)	82 (17.3%)
	With other children	203 (10.2%)	149 (9.8%)	54 (11.4%)
	With parents	545 (27.4%)	430 (28.4%)	115 (24.3%)
Occupation <i>n</i> (%)	Other	83 (4.2%)	55 (3.6%)	28 (5.9%)
	Student	269 (13.5%)	228 (15.0%)	41 (8.6%)
	Employed	1,174 (59.0%)	863 (57.0%)	311 (65.6%)
	Health related work	103 (5.2%)	87 (5.7%)	16 (3.4%)
	Homemaker	32 (1.6%)	31 (2.0%)	1 (0.2%)
	Unemployed	96 (4.8%)	81 (5.3%)	15 (3.2%)
	Retired	61 (3.1%)	35 (2.3%)	26 (5.5%)
	Other	250 (12.6%)	187 (12.3%)	63 (13.3%)
	Missing	4 (0.2%)	3 (0.2%)	1 (0.2%)
	Number of household members			
	0	263 (13.2%)	190 (12.5%)	73 (15.4%)
	1	687 (34.5%)	533 (35.2%)	154 (32.5%)
	2	496 (24.9%)	384 (25.3%)	112 (23.6%)
	3	421 (21.2%)	312 (20.6%)	109 (23.0%)
	4	98 (4.9%)	76 (5.0%)	22 (4.6%)
	5	21 (1.1%)	17 (1.1%)	4 (0.8%)
	6	2 (0.1%)	2 (0.1%)	0 (0.0%)
	7	1 (0.1%)	1 (0.1%)	0 (0.0%)
Pandemic impact				
Tested positive <i>n</i> (%)	Yes	26 (1.3%)	23 (1.5%)	3 (0.6%)
	No	1,955 (98.3%)	1,485 (98.0%)	470 (99.2%)
	Missing	8 (0.4%)	7 (0.5%)	1 (0.2%)
Increased use of devices <i>n</i> (%)	Yes	1,640 (82.5%)	1,290 (85.1%)	350 (73.8%)
	No	334 (16.8%)	213 (14.1%)	121 (25.5%)
	Missing	15 (0.8%)	12 (0.8%)	3 (0.6%)
Eating habits <i>n</i> (%)	Yes, I eat more	778 (39.1%)	597 (39.4%)	181 (38.2%)
	Yes, I eat less healthy	227 (11.4%)	189 (12.5%)	38 (8.0%)
	Yes, I eat less	158 (7.9%)	118 (7.8%)	40 (8.4%)
	Yes, I eat more healthy	261 (13.1%)	194 (12.8%)	67 (14.1%)
	No, not changed	559 (28.1%)	413 (27.3%)	146 (30.8%)
Change in work satisfaction (Mean $\pm$ SD)		-14.7 $\pm$ 24.52	-15.2 $\pm$ 24.83	-13.2 $\pm$ 23.56
Mental health				
Current insomnia <i>n</i> (%)	No	1,792 (90.1%)	1,351 (89.2%)	441 (93.0%)
	Yes	197 (9.9%)	164 (10.8%)	33 (7.0%)
Past insomnia <i>n</i> (%)	Yes	276 (13.9%)	228 (15.0%)	48 (10.1%)
	No	1,713 (86.1%)	1,287 (85.0%)	426 (89.9%)
Current mental disorders (other than insomnia)	Yes	299 (15.0%)	253 (16.7%)	46 (9.7%)
	No	1,690 (85.0%)	1,262 (83.3%)	428 (90.3%)

(Continued)

TABLE 1 | Continued

Variables		Overall	Females	Males
Past mental disorders (other than insomnia)	Yes	577 (29.0%)	480 (31.7%)	97 (20.5%)
	No	1,412 (71.0%)	1,035 (68.3%)	377 (79.5%)
Medical health				
Current disorders <i>n</i> (%)	Yes	299 (15.0%)	253 (16.7%)	46 (9.7%)
	No	1,690 (85.0%)	1,262 (83.3%)	428 (90.3%)

Region: North was composed of Lombardia, Piemonte, Veneto, Liguria, Emilia Romagna, Valle D'Aosta, Trentino Alto Adige, Friuli Venezia Giulia; Center was composed of Lazio, Toscana, Marche, Umbria; South was composed of Abruzzo, Molise, Campania, Basilicata, Puglia, Calabria; Islands: Sicily, Sardinia; Current/past mental disorder: insomnia, depression, bipolar disorder, anxiety, panic attack, post-traumatic stress disorder, anorexia, bulimic, obsessive compulsive disorder, post-partum depression, other, and specify; change in work satisfaction was calculated as current satisfaction in a scale from 0 to 100 minus past satisfaction in a scale from 0 to 100.

TABLE 2 | Participants scores at questionnaires.

Questionnaires		Total	Females	Males
ISI total score	Mean $\pm$ StD	8.4 $\pm$ 6.20	8.6 $\pm$ 6.18	7.7 $\pm$ 6.23
SHI total score	Mean $\pm$ StD	12.8 $\pm$ 7.32	12.9 $\pm$ 7.37	12.4 $\pm$ 7.15
DBAS-16 total score	Mean $\pm$ StD	33.7 $\pm$ 18.23	34.5 $\pm$ 18.05	31.1 $\pm$ 18.56
MEQ categories	Morning type <i>n</i> (%)	390 (19.6%)	285 (18.8%)	105 (22.2%)
	Intermediate type <i>n</i> (%)	1,329 (66.8%)	1,025 (67.7%)	304 (64.1%)
	Evening type <i>n</i> (%)	270 (13.6%)	205 (13.5%)	65 (13.7%)
ERQ-CR total score	Mean $\pm$ StD	28.9 $\pm$ 7.25	29.2 $\pm$ 7.23	28.1 $\pm$ 7.27
ERQ-ES total score	Mean $\pm$ StD	13.2 $\pm$ 5.42	12.6 $\pm$ 5.39	14.9 $\pm$ 5.15
CFI total score	Mean $\pm$ StD	104.5 $\pm$ 17.17	103.6 $\pm$ 17.11	107.2 $\pm$ 17.09
PSS total score	Mean $\pm$ StD	19.7 $\pm$ 7.33	20.6 $\pm$ 7.15	16.9 $\pm$ 7.19
HADS anxiety total score	Mean $\pm$ StD	7.9 $\pm$ 3.89	8.3 $\pm$ 3.86	6.6 $\pm$ 3.72
HADS depression total score	Mean $\pm$ StD	6.0 $\pm$ 3.72	6.2 $\pm$ 3.72	5.5 $\pm$ 3.70

ISI, Insomnia Severity Index; SHI, Sleep Hygiene Index; DBAS, Dysfunctional Beliefs and Attitudes about Sleep; MEQ, Morningness Eveningness Questionnaire; ERQ-CR, Emotion Regulation Questionnaire-Cognitive Reappraisal; ERQ-ES, Emotion Regulation Questionnaire-Emotion Suppression; CFI, Cognitive Flexibility Inventory; PSS, Perceived Stress Scale; HADS, Hospitalized Anxiety and Depression scale.

did not reveal any substantial differences between the two analysis populations (see **Supplementary Document 1**). All further analysis were conducted on the main analysis set. Results for descriptive statistics were expressed in means $\pm$ standard deviations for continuous variables and in absolute and relative frequencies for categorical variables. Stratified analyses allow to assess effects in specific strata thus reducing bias. A linear multivariable regression model was used to determine the association between several independent variables considered as predictors and severity of insomnia as outcome. Predictors included sex, age, past self-reported insomnia, past mental disorder, current self-reported insomnia, current self-reported mental disorder, expressive suppression (ES), cognitive reappraisal (CR), cognitive flexibility, perceived stress, sleep hygiene behaviors, dysfunctional beliefs about sleep, exercise behavior, eating behavior, drinking behavior, use of electronic devices, region of residence, health related work, tested positive to the virus, mourning, number of household members, circadian preference, anxiety, and depression. A detailed list of all variables and their description is reported in **Supplementary Document 2**. The Bonferroni-Holm method (42) was used to adjust for multiple testing. Multicollinearity among factors was examined by analyzing

the (generalized) variance inflation factors with a cut-off of 5 (43).

RESULTS

Sample Characteristics

A total of 2,652 individuals gave consent and answered the survey. 1989 completed all validated questionnaires, and were used for the main analyses.

In **Table 1** the main sample characteristics are presented. All descriptive data are available in **Supplementary Document 1**. One thousand, five hundred fifteen were females (37.5 ± 12.42 yrs) and 474 males (41.4 ± 13.8 yrs). The mean age of participants was 38.4 ± 12.8 yrs. (age range: 18–90). 39.7% of the participants came from the north of Italy, 35.6% from the center, 17.7% from the south, and 6.1% from the islands. 27.4% lived home confinement situation in the same home with parents, 27% with partner, and 13.2% alone.

Fifty-nine percentage of participants reported to be employed and 5% to have a health related work. 13.7% reported to be students, 5.2% unemployed, 1.8% homemaker, and 3.2% retired. For working participants, a severe average decrease in work satisfaction compared to before home confinement (calculated

TABLE 3 | Prevalence of insomnia.

	Overall				Female				Male			
	Age 18–30 (n = 666)	Age 31–65 (n = 1,258)	Age >65 (n = 65)	All ages (n = 1,989)	Age 18–30 (n = 539)	Age 31–65 (n = 937)	Age >65 (n = 39)	All ages (n = 1,515)	Age 18–30 (n = 127)	Age 31–65 (n = 321)	Age >65 (n = 26)	All ages (n = 474)
Absence of insomnia n (%)	280 (42.0)	654 (52.0)	43 (66.2)	977 (49.1)	231 (42.9)	457 (48.8)	24 (61.5)	712 (47.0)	49 (38.6)	197 (61.4)	19 (73.1)	265 (55.9)
Subthreshold insomnia n (%)	234 (35.1)	394 (31.3)	14 (21.5)	642 (32.3)	192 (35.6)	312 (33.3)	11 (28.2)	515 (34.0)	42 (33.1)	82 (25.5)	3 (11.5)	127 (26.8)
Moderate insomnia n (%)	129 (19.4)	177 (14.1)	8 (12.3)	314 (15.8)	98 (18.2)	140 (14.9)	4 (10.3)	242 (16.0)	31 (24.4)	37 (11.5)	4 (15.4)	72 (15.2)
Severe insomnia n (%)	23 (3.5)	33 (2.6)	0 (0.0)	56 (2.8)	18 (3.3)	28 (3.0)	0 (0.0)	46 (3.0)	5 (3.9)	5 (1.6)	0 (0.0)	10 (2.1)

as current satisfaction in a scale from 0 to 100 minus past satisfaction in a scale from 0 to 100) was observed (-14.7 ± 24.5).

13.9% reported suffering in the past from insomnia disorder and 29% of other mental disorder. 9.9% of participants reported to suffer of current insomnia, 15% reported current mental disorder, and 15% reported current medical disorder. 69.7% of participants did not regularly assume drugs.

Most participants reported increased use of electronic devices during home confinement (82.5%); 49.7% continued to do exercise also in quarantine and 39.1% reported to eat more during this period. Among all respondents, 1.3% was infected with Covid-19 and 6.7% lost a loved one during the isolation period (mourning). Overall worry over Covid-19 was high (in a range from 1 to 100: overall: 68 ± 23.22 , F: 69.9 ± 22.23 , M: 61.6 ± 25.16). Worry to be infected (in a range from 0 to 100: overall: 42.5 ± 27.07 , F: 43.6 ± 27.09 , M: 39 ± 26.7) was lower with respect to worry that a loved one could be infected (in a range from 1 to 100: overall: 68.0 ± 28.13 , F: 70.0 ± 27.75 , M: 61.7 ± 28.41).

In **Table 2** average scores of participants to the questionnaire are provided. Specifically, overall, high average of insomnia severity (8.4 ± 6.20 ; F: 8.6 ± 6.1 ; M: 7.7 ± 6.2) was observed. Males of our sample reported slightly less dysfunctional beliefs about sleep (31.1 ± 18.56) compared to females (34.5 ± 18.05). Regarding circadian preferences, 19.6% of our sample reported morning, 66.8% intermediate and 13.6% evening chronotype. Perceived stress was scored as lower in males (16.9 ± 7.19) compared to females (20.6 ± 7.15). Participants reported an average anxiety score of 7.9 ± 3.89 and an average depression score of 6.0 ± 3.72 (in both cases scores were higher in females than males). Overall, participants used more cognitive reappraisal strategy (28.9 ± 7.25) than emotion suppression strategy (13.2 ± 5.42). Finally, participants reported a mean cognitive flexibility score of 104.5 ± 17.17 .

Prevalence of Insomnia

Considering insomnia severity (ISI), 49.1% presented absence of insomnia; 32.3% presented subthreshold insomnia, 18.6% reported clinical insomnia (15.8% symptoms for moderate insomnia, and 2.8% symptoms of severe insomnia). As showed in **Table 3**, females reported higher prevalence of clinical insomnia (moderate insomnia + severe insomnia = 19.0%) compared to males (17.3%). High prevalence of insomnia was observed in the

18–30 age group, with extreme rates for males (22.9% moderate insomnia + severe insomnia, F: 21.5%; M: 28.3%).

Severity of Insomnia in Relevant Subgroups

Table 4 shows insomnia severity means in relevant subgroups (indicated in the gray boxes in **Figure 1**). Subgroups showing more severe insomnia were people who reported current presence of insomnia (13.8 ± 4.96) or other mental disorder (13.5 ± 6.03); individuals living with parents (9.5 ± 6.42); participants aged 18–30 (9.3 ± 6.17), people with evening chronotype (10.8 ± 6.42), participants in mourning (9.2 ± 6.22), those living alone (9.0 ± 6.23), and those living in 5 or more in the same house (9.1 ± 6.36).

Differences in Relevant Processes by Insomnia Status

Table 5 shows mean levels of relevant processes (indicated in the white boxes in **Figure 1**) by insomnia status. Emotional suppression, cognitive reappraisal, cognitive flexibility, perceived stress, sleep hygiene behaviors, dysfunctional beliefs about sleep, anxiety, and depression were evaluated in individuals with different insomnia status, based on the ISI questionnaire. Results showed clear association of insomnia severity with reduced levels of sleep hygiene and cognitive flexibility, and, increased levels of stress, anxiety, depression, and dysfunctional beliefs about sleep.

Identification of Factors Associated With Insomnia

Results of linear multivariable regression model are presented in **Figure 2** while specific results for all investigated covariates are available in **Supplementary Document 2**. No substantial changes in the results' interpretation were found after adjusting for multiple testing. No indication for multicollinearity among these variables in the analysis (GVIF < 5) was observed. Large effects were detected for self-report of current insomnia [$\beta = 2.77$, 95% (0.97; 4.58), $p < 0.005$] and self-report of current mental disorder [$\beta = 2.51$, 95% CI (1.82; 3.19), $p < 0.001$]. Furthermore, results showed that poor sleep hygiene behaviors [$\beta = 0.11$, 95% CI (0.07; 0.14), $p < 0.001$] and dysfunctional beliefs about sleep [$\beta = 0.09$, 95% CI (0.08; 0.11), $p < 0.001$] are significantly associated to insomnia severity. Finally, results highlighted a significant role of

TABLE 4 | Insomnia severity in relevant population subgroups.

		<i>n</i>	Mean ± StD
Overall		1,989	8.4 ± 6.20
Sex	Female	1,515	8.6 ± 6.18
	Male	474	7.7 ± 6.23
Age	18–30	666	9.3 ± 6.23
	31–65	1,258	8.0 ± 6.17
	>65	65	6.3 ± 5.43
Health related work	Yes	103	8.4 ± 5.81
	No	1,882	8.4 ± 6.23
Tested positive	Yes	26	8.1 ± 6.31
	No	1,955	8.4 ± 6.21
Mourning	Yes	133	9.2 ± 6.22
	No	1,850	8.4 ± 6.20
Current mental disorder	Any mental disorder (± insomnia)	299	13.5 ± 6.03
	Insomnia only	31	13.8 ± 4.96
	No mental disorder	1,659	7.4 ± 5.73
Family status	Alone	263	8.9 ± 6.72
	With partner	537	7.6 ± 5.79
	With at least one child below 13	358	7.7 ± 6.08
	With other children	203	8.1 ± 5.58
	With parent(s)	545	9.5 ± 6.42
	Other	83	9.3 ± 6.56
Number of household members	1	263	8.9 ± 6.72
	2	687	7.9 ± 6.02
	3–4	917	8.6 ± 6.15
	≥5	122	9.1 ± 6.36
Circadian preference	Morning type	390	7.5 ± 6.29
	Intermediate type	1,329	8.2 ± 6.05
	Evening type	270	10.8 ± 6.27
Region	North	790	8.4 ± 6.29
	Other	1,199	8.4 ± 6.15

anxiety [$\beta = 0.33$, 95% CI (0.25; 0.42), $p < 0.001$] and depression [$\beta = 0.24$, 95% CI (0.16; 0.32), $p < 0.001$] symptoms as predictors of insomnia.

DISCUSSION AND CLINICAL IMPLICATIONS

The present study aimed at determining the prevalence of insomnia disorder and its association with several relevant factors in the Italian adult population during Covid-19 outbreak. Results showed an alarming high prevalence of clinical insomnia of 18.6%, compared to normative data from Europe of 10.1% and from Italy of 7.0% (44, 45). Future studies, in Italy and in other

countries, should investigate further the effects of the pandemic's outbreak on insomnia comparing data during and after the pandemic in order to promote cross-cultural comparisons. Specifically, wide-ranging online investigations, using validated questionnaires in different languages, could evaluate the trend of psychological variables with the progress of the pandemic up to the post-pandemic time.

Higher prevalence rates were observed in young males (18–30 yrs). Consistently, high means of insomnia severity were found in those living with parents, mainly overlapping with the young adults group. Some aspects of home confinement, e.g., deprivation from physical social life with peers, increase of virtual social life and time with parents at home, may have challenged mental health particularly in younger individuals (and our results suggest in males more than in females). Instead, participants >65 yrs. did not show high levels of insomnia severity and resulted to be averagely in good health. This may be explained by the fact that only those with high functioning and technological skills answered to our survey. Higher prevalence of insomnia severity was observed in people in mourning and in individuals reporting mental disorders, consistently with previous hypotheses [e.g., (1)].

A clear association was evidenced between insomnia severity and poor sleep hygiene behaviors, dysfunctional beliefs about sleep, anxiety, depression, perceived stress, and cognitive flexibility. Sleep, insomnia, stress, emotion and behavior regulation, and cognitive flexibility represent transdiagnostic processes in mental health. Recent findings showed that Cognitive and Behavior Therapy (CBT) may be strongly supported by empirical findings and respond adequately to individual complex conditions [e.g., (46)]. In the pandemic context, targeting transdiagnostic processes to increase resilient, and adjustment responses seem particularly promising.

Results from linear regression model showed that factors most associated with insomnia severity are: psychopathology (i.e., current present of mental disorder, higher means in measures of depression and anxiety symptoms), and behaviors and cognitions associated to sleep (i.e., poor sleep hygiene behaviors; and dysfunctional beliefs about sleep). Sex and age were not identified as associated *per se* with insomnia severity, suggesting that they could be confounders.

Insomnia is commonly associated to depression, anxiety, and mental disorders in general (47), and cumulative evidence highlighted its transdiagnostic nature in psychopathology [e.g., (3)]. Insomnia disorder (with or without comorbidities) responds to its specific treatment [Cognitive Behavior Treatment for Insomnia, CBT-I, (15, 44)]. Instead, it often persists after successful treatment of other conditions, such as depression (48). Based on this literature, CBT-I could be successfully offered to all patients with mental disorders presenting insomnia, as indicated in preliminary clinical research. Specifically, recent data showed that treating insomnia by offering CBT-I to patients with mental disorders could have important benefits [e.g., (49)]. Nevertheless, the standard CBT-I protocol may need to be adapted depending on patients specific symptomatology. For example, patients with bipolar disorder may not benefit by sleep restriction, which is a key behavioral strategy in the

TABLE 5 | Differences in relevant processes by insomnia severity subgroups.

Variables	Absence of insomnia	Subthreshold insomnia	Moderate insomnia	Severe insomnia
SHI (Mean $\pm$ StD)	10.3 $\pm$ 6.07	14.0 $\pm$ 7.30	17.0 $\pm$ 7.11	20.9 $\pm$ 8.72
ERQ-CR (Mean $\pm$ StD)	29.7 $\pm$ 7.12	28.8 $\pm$ 7.05	27.4 $\pm$ 7.29	25.8 $\pm$ 9.28
ERQ-ES (Mean $\pm$ StD)	12.5 $\pm$ 5.29	13.4 $\pm$ 5.40	14.4 $\pm$ 5.57	14.0 $\pm$ 5.75
PSS (Mean $\pm$ StD)	16.6 $\pm$ 6.56	21.2 $\pm$ 6.59	24.6 $\pm$ 6.45	27.8 $\pm$ 6.04
HADS anxiety (Mean $\pm$ StD)	6.1 $\pm$ 3.13	8.5 $\pm$ 3.46	10.9 $\pm$ 3.57	14.1 $\pm$ 3.56
HADS depression (Mean $\pm$ StD)	4.4 $\pm$ 3.13	6.6 $\pm$ 3.26	8.8 $\pm$ 3.55	10.5 $\pm$ 4.01
DBAS-16 (Mean $\pm$ StD)	25.6 $\pm$ 14.61	36.6 $\pm$ 15.97	47.5 $\pm$ 16.81	64.1 $\pm$ 18.05
CFI (Mean $\pm$ StD)	107.6 $\pm$ 15.70	102.9 $\pm$ 17.34	99.5 $\pm$ 18.08	95.4 $\pm$ 22.38

ISI, Insomnia Severity Index; SHI, Sleep Hygiene Index; ERQ, Emotion Regulation Questionnaire; CR, Cognitive reappraisal; ES, expressive suppression; PSS, Perceived Stress; HADS, Hospital Anxiety and Depression Scale; DBAS, Dysfunctional Beliefs and Attitudes about Sleep; CFI, Cognitive Flexibility Inventory.

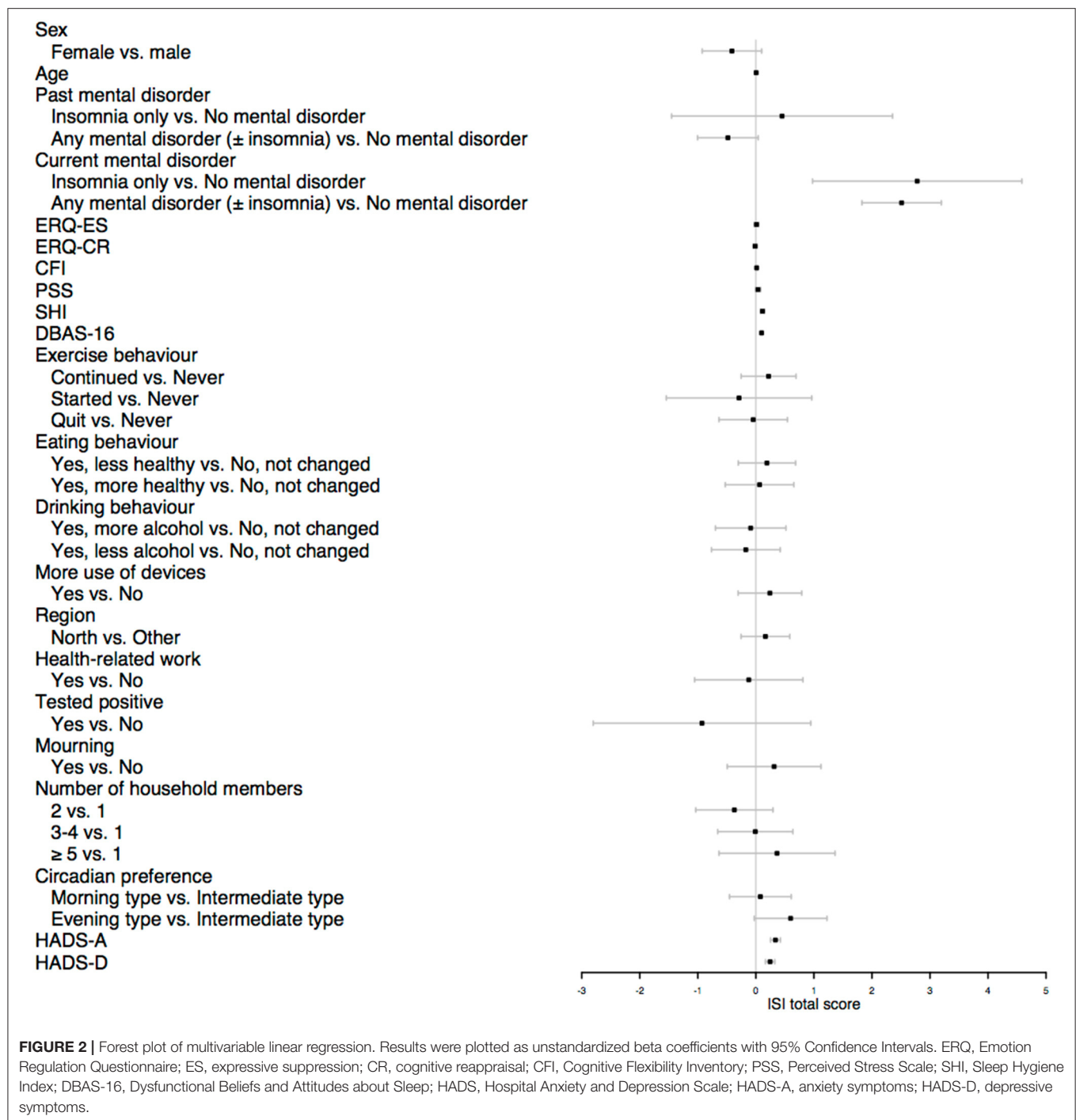
CBT-I protocol, consisting in limiting the amount of time you allow yourself to sleep in the bed, because of its potential role in triggering manic episodes (50). Harvey et al. (50) conducted a randomized controlled trial comparing 30 bipolar patients who received bipolar disorder-specific modification of CBT-I and 28 patients who received psychoeducation therapy. The authors found that the experimental group experienced significantly lower hypomania/mania relapse rate, reduced insomnia severity, and higher rates of insomnia remission at posttreatment compared to the psychoeducation control group.

Furthermore, post-traumatic stress disorder is often associated with insomnia, characterized by hypervigilance at night and fear of going to bed or to sleep (51). Thus, much of the studies investigating insomnia in this population had included in the CBT-I a specific intervention targeting nightmares. Specifically, imagery rehearsal therapy, a form of cognitive therapy targeting nightmares consisting in recalling the nightmare, changing any part of the dream to a more positive one, and rehearsing the rewritten dream scenario, is recommended for treatment of post-traumatic-related nightmares (52). Further clinical research is needed to deepen the efficacy of CBT-I and adapted protocols for insomnia in comorbidities with different psychopathologies, and also to better understand the promising role of CBT-I in preventing mental disorders.

Since the alarming presence of high prevalence of clinical insomnia which was observed in correspondence of Covid-19 outbreak, implementing CBT-I in the mental health services and in primary care could be very useful to prevent the development of psychopathologies.

Despite the cross-sectional nature of this study, results suggest an important preventive role of sleep hygiene behaviors and adequate knowledge about sleep in the development

of a clinically relevant disorder. Since, the role of sleep hygiene knowledge was already showed in previous literature, high quality clinical programs in the post-pandemic scenario, targeting sleep and insomnia could be implemented in primary care [for a review see (44)]. This could be especially important in younger adults, in order to investigate their health preventive and promotion role. This seems to be specifically important in this second phase of the pandemic, in which mental health operators should make all efforts to contain and repair the damages which long home confinement has provoked. Studies could further investigate the longitudinal course of sleep patterns and behaviors in the different phases of the pandemic and in the post-pandemic context. Furthermore, future longitudinal studies could explore further the association between sleep hygiene behaviors and insomnia in the general population and in mental disorders patients. Finally, a meta-analysis that systematically summarize cross-cultural data on insomnia prevalence and its association with mental health consequences could be very helpful to have a complete picture of Covid-19 impact in the different countries. This study presents some limitations. Sampling bias cannot be excluded. Our sample included more females than males, and more younger people than elderly and, as mentioned above, the older group showed high health quality. In order to try to control this potential sampling bias gender and age stratified analyses for main parameters of interest were conducted. Furthermore, the questionnaire was relative long, which had caused a number of individuals to not complete all the survey. Nevertheless, no obvious differences between enrolled set and main analysis set was observed. Furthermore, the cross-sectional nature of this study limits an accurate interpretation of the results. Finally, the comparison between pre and during-pandemic data on insomnia prevalence was made comparing data of our study and epidemiological data from 2002 and this could represent a limitation in the interpretation of the results. Indeed, the



prevalence of insomnia may have been increased already before the pandemic. Nevertheless, it seems unlikely that such a relevant change in prevalence is independent on life changes caused by the Covid-19 pandemic's outbreak. Several strengths may be also underlined. The sample size was large, thus, allowing us to observe interactions between several variables, and exploring the complexity of real life individual vulnerabilities to insomnia

difficulties. Future research should evaluate the effect of Covid-19 spread in Italy after the lockdown in order to assess the trend of insomnia symptoms, anxiety and depression after the worst moments of the health emergency. This would be informative about longitudinal impact of the pandemic on mental health in the Italian population and provide important data for the post-pandemic scenario.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethic Committee for research in psychological area, University of Study Guglielmo Marconi, Rome (Italy). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

CBa and VB contributed to the ideas of the research, collection of data, and empirical analysis. MC contributed to the data analysis, design of research methods, and tables. FM, CBu, PD, and DR participated in developing a research design, writing,

and interpreting the analysis. All the authors contributed to the literature review and conclusions.

ACKNOWLEDGMENTS

We would like to thank all participants who took their time to fill in the survey. We would also like to thank all institutions who helped us to distribute the survey to reach interested participants: University of Rome Guglielmo Marconi, Scuola di Psicoterapia Cognitiva (SPC), Società Italiana di Psicoterapia Comportamentale e Cognitiva (SITCC), Centro Medico Santagostino (CMS), daily newspaper La Stampa, European Academy for Cognitive Behavioral Therapy for Insomnia (European CBT-I Academy).

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2020.579107/full#supplementary-material>

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Worsening of Preexisting Psychiatric Conditions During the COVID-19 Pandemic

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OPEN ACCESS

Edited by:

Paola Aceto,
Catholic University of the Sacred
Heart, Italy

Reviewed by:

S. M. Yasir Arafat,
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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 04 August 2020

Accepted: 13 November 2020

Published: 16 December 2020

Citation:

Gobbi S, Plomecka MB, Ashraf Z,
Radziński P, Neckels R, Lazzeri S,
Dedić A, Bakalović A, Hrustić L,
Skórko B, Es haghi S, Almazidou K,
Rodríguez-Pino L, Alp AB, Jabeen H,
Waller V, Shibli D, Behnam MA,
Arshad AH, Barańczuk-Turska Z,
Haq Z, Qureshi SU and Jawaid A
(2020) Worsening of Preexisting
Psychiatric Conditions During the
COVID-19 Pandemic.
Front. Psychiatry 11:581426.
doi: 10.3389/fpsy.2020.581426

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Objectives: To ascertain factors associated with worsening of psychiatric conditions during the coronavirus disease 2019 (COVID-19) pandemic.

Methods: This study anonymously examined 2,734 psychiatric patients worldwide for worsening of their preexisting psychiatric conditions during the COVID-19 pandemic. An independent clinical investigation of 318 psychiatric patients from United States was used for verification.

Results: Valid responses mainly from 12 featured countries indicated self-reported worsening of psychiatric conditions in two-thirds of the patients assessed that was through their significantly higher scores on scales for general psychological disturbance, posttraumatic stress disorder, and depression. Female gender, feeling no control of the situation, reporting dissatisfaction with the response of the state during the COVID-19 pandemic, and reduced interaction with family and friends increased the worsening of preexisting psychiatric conditions, whereas optimism, ability to share concerns with family and friends, and using social media like usual were associated with less worsening. An independent clinical investigation from the United States confirmed worsening of psychiatric conditions during the COVID-19 pandemic based on identification of new symptoms that necessitated clinical interventions such as dose adjustment or starting new medications in more than half of the patients.

Conclusions: More than half of the patients are experiencing worsening of their psychiatric conditions during the COVID-19 pandemic.

Keywords: COVID-19, psychiatric patients, worsening, depression, post traumatic stress disorder, general psychological disturbance

Coronavirus disease 2019 (COVID-19) has emerged as the most critical global crisis of the 21st century. COVID-19 cases have exceeded 30 million as of September 28, 2020 (1). A number of studies have indicated an increase in anxiety, depression, and other psychopathologies during the COVID-19 pandemic (2–7). Such disturbances have occurred, in particular, in individuals with previous history of psychological illness, who have also been found to be at increased risk of contracting COVID-19 (8). Furthermore, worsening of psychiatric conditions has also been associated with higher risk of suicidal ideation (9, 10).

Psychiatric conditions constitute a significant burden on healthcare systems and economy (4, 11–13). The COVID-19 pandemic has given rise to even greater challenges for an already struggling system of mental health care. Moreover, it has been associated with an increase in use of mental health and suicide prevention helplines (14). Furthermore, new methods of psychological/psychiatric care delivery through telemedicine are being increasingly adopted (15). It is paramount for the optimization of mental healthcare delivery during these challenging times that the most vulnerable populations are efficiently identified.

To address this, we analyzed the data from participants with preexisting psychiatric conditions from our global study on the mental health impact of COVID-19 (10). Each patient report of worsening of psychiatric conditions was then cross-analyzed with participants' demographics, opinions/outlooks, personality traits, current household conditions, previous history, and other factors associated with COVID-19 to identify risk and resilience factors for worsening psychiatric condition. The results were then verified in an independent clinical cohort of psychiatric patients that consulted a psychiatry practice in Houston, TX, USA, during the COVID-19 pandemic.

METHODS

Study Design

The study comprised two independent evaluations: (1) a cross-sectional electronic survey-based assessment of individuals older than 18 years willing to participate in the study and (2) evaluation of anonymized clinical records of psychiatric patients older than 18 years.

Online Survey

The anonymous online survey was conducted among participants from diverse demographic groups to examine the status of their preexisting psychiatric conditions that were verified via standardized self-report scales for general psychological disturbance, risk for posttraumatic stress disorder (PTSD), symptoms of depression, and suicidal ideation. The

survey was available online for a period of 15 consecutive days beginning 18:00 Central European Time on March 29, 2020, and concluding on 18:00 Central European Time on April 14, 2020.

The questionnaire was developed through close consultation between a neuroscientist, a neuropsychologist, a psychiatrist, a data scientist, and a psychiatry clinic manager. The questionnaire included closed-ended questions that assessed participant characteristics and opinions and screened for neuropsychiatric symptoms through standardized and validated self-report scales. The questionnaire prototype was prepared in English (**Appendix 1**) and translated into 10 additional languages (Arabic, Bosnian, French, German, Greek, Italian, Persian, Polish, Spanish, and Turkish; **Appendix 2**). The translation was performed by bilingual native speakers and vetted by volunteers native to those countries. The feasibility of each questionnaire was confirmed using pilot studies that comprised 10 participants each. These responses were excluded from the final analysis.

The questionnaires (**Appendix 1**) included a section on participant demographics (age, gender, country, residential setting, educational status, current employment status), household conditions (working/studying from home, home isolation conditions, pet ownership, level of social contact, social media usage, time spent exercising), COVID-19-related factors (knowing a coworker, friend, or family member who tested positive for or demised due to COVID-19; prediction about pandemic resolution), personality traits (level of optimism, level of extroversion), previous history of psychiatric disease and/or trauma, previous exposure to human crisis, and level of satisfaction with actions of the state and employer during the current crisis. All questionnaires were rated on binary (yes/no) responses or Likert-type scales.

The other sections contained general health assessment based on World Health Organization (WHO) Self-Reporting Questionnaire-20 (SRQ), Impact of Event Scale (IES), and Beck's Depression Inventory II (BDI) (16–18). These scales were chosen based on their usage and efficacy in previously employed works studying the psychological impact of human crises such as the severe acute respiratory syndrome epidemic (19–27). IES wording was purposefully adjusted to assess the impact of an ongoing event rather than a past event.

Using a nonrandomized referral sampling (snowball sampling) method, participants were contacted by a team of 70 members (study authors and volunteers who have been acknowledged in the *Acknowledgments*) using electronic communication channels including posts on social media platforms, direct digital messaging, and personal and professional email lists. For the survey, 12 countries

were included in the “featured” list. These countries included United States, Spain, Italy, France, Germany, Iran, Turkey, Switzerland, Canada, Poland, Bosnia and Herzegovina, and Pakistan. The data collection procedures were repeated at least thrice during the data collection period (March 29–April 14, 2020).

An overall total of 13,332 responses were collected. Surveys were excluded if they were completed by participants who were younger than 18 years ($n = 34$), were missing responses for all dependent variables ($n = 112$), had been submitted previously ($n = 325$), were missing geographic location ($n = 20$), or were from WHO AFRO region ($n = 24$). When the responses were missing for individual items, the missing data were considered null and excluded from the analysis for that particular variable. In this follow-up study, however, only responses from participants who reported suffering from a previous psychiatric condition ($n = 2,734$) were considered valid.

Clinical Study

The clinical data were extracted and analyzed for all the adult patients who consulted for online follow-up clinical evaluations at a psychiatric care facility (Texas Behavioral Health) based in Houston, TX, USA, during March 29–April 14, 2020. The inclusion criteria were previous diagnosis of major depressive disorder or anxiety disorders (generalized anxiety disorder and PTSD). Patients with diagnoses other than these and those younger than 18 years were excluded. Only the data from patients consenting to use of their records for this research were included in the study.

Clinical data for each patient were examined by clinic assistants blinded to the study design. The following information was extracted: age, gender, home-isolation status during COVID-19, social support during COVID-19, past exposure to trauma or a human crisis situation, and clinical diagnosis. Worsening of psychiatric conditions was assessed based on clinician report of new symptoms, need to increase or adjust the medication, and referral for a new therapy.

Data from 318 patients were considered valid for analysis. When the responses were missing for individual items, the missing data were considered null and excluded from the analysis for that particular variable.

Ethical Considerations

Informed consent was obtained from each survey and clinical participant to allow anonymous recording, analysis, and publication of their answers. The data were collected in a completely anonymous fashion without recording any personal identifiers, and the confidentiality of the participants was maintained throughout all phases of the study. The study procedures were reviewed and approved by the University of Zurich Research Office for Scientific Integrity and Cantonal Ethics Commission for the canton of Zurich (Switzerland), BRAINCITY, Nencki Institute of Experimental Biology, Warsaw (Poland), and the Faculty of Medicine, University of Tuzla, Tuzla (Bosnia and Herzegovina).

Statistical Analysis

All statistical analyses were performed using R version v.3.6.3 and *Rstudio* (28). All figures were produced using the packages *ggplot2* (29) and *CGPfunctions* (30).

Unadjusted analysis for worsening of psychiatric conditions in both the survey and the clinical cohort involved Fisher exact test. For the survey, the categorical predictors included gender, residential status, education level, employment status, being a medical professional, working remotely from home, satisfaction with employer, satisfaction with the state (government), home-isolation status, interaction with family and friends, social media usage, ability to share concerns with a mental health professional, ability to share concerns with family and friends, prior exposure to a human crisis situation, previous exposure to trauma, level of extroversion, prediction about COVID-19 resolution, and one's self-determined role in the pandemic. For the clinical study, the categorical predictors included age, gender, home isolation status, and social support during home isolation.

Multiple logistic regression models were built to generate odds ratios (ORs) for worsening of psychiatric conditions both in the survey and the clinical cohorts. All statistical analyses were performed by the analysis team comprising MP, SG, PR, and AJ in consultation with ZB.

RESULTS

Survey Study

Demographics

A total of 2,734 responses were considered valid with the highest responses from the United States (874), Poland (255), Canada (246), Spain (205), and Pakistan (203). The distribution of the responses across the 12 featured countries and the WHO regions is presented in **Supplementary Item 1**. Canada had the highest (80.89%) proportion of patients reporting worsening of their psychiatric condition followed by Pakistan (72.41%) and the United States (67.5%). Turkey had the lowest percentage (28.57%) for worsening of psychiatric conditions (**Figure 1**).

There was a disproportion in valid responses, with higher numbers from those participants who were female (79.44%); residing in urban areas (84.6%); with advanced educational qualification, i.e., bachelor's degree or higher (71.5%); working/studying remotely from home (65%); and currently under home isolation with a partner/family (82.77%). Also notable were responses expressing some level of satisfaction with COVID-19-related employer (52.67%) and state response (64.26%) and spending <15 min on daily physical exercise (52.99%). A majority of participants also reported increased social media usage (65.42%), less-than-usual or minimal interaction with family and friends (64.88%), and feeling some level of control in protecting themselves and others during the COVID-19 pandemic (94.36%).

Participants' report of worsening of psychiatric conditions was verified by comparing the SRQ, IES, and BDI scores between

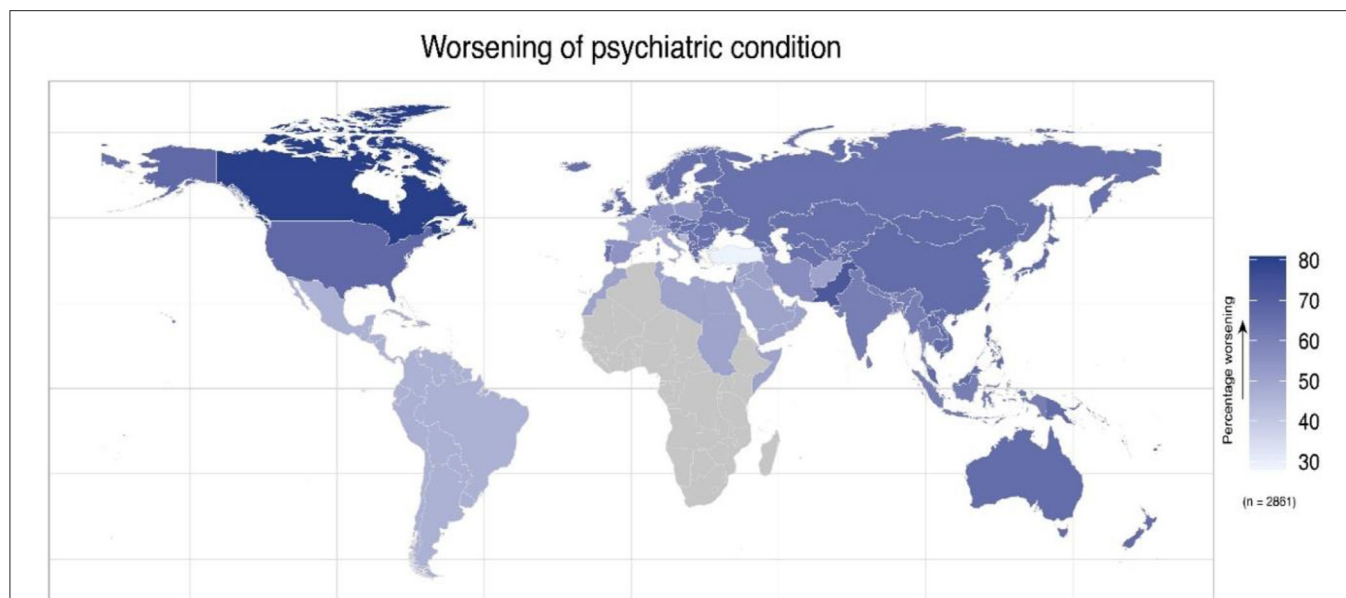


FIGURE 1 | Geodemographic representation of the survey participants with preexisting psychiatric condition that reported worsening of their condition. The map shows the percentage of worsening preexisting psychiatric conditions separately for each of the featured countries and for each of WHO regions.

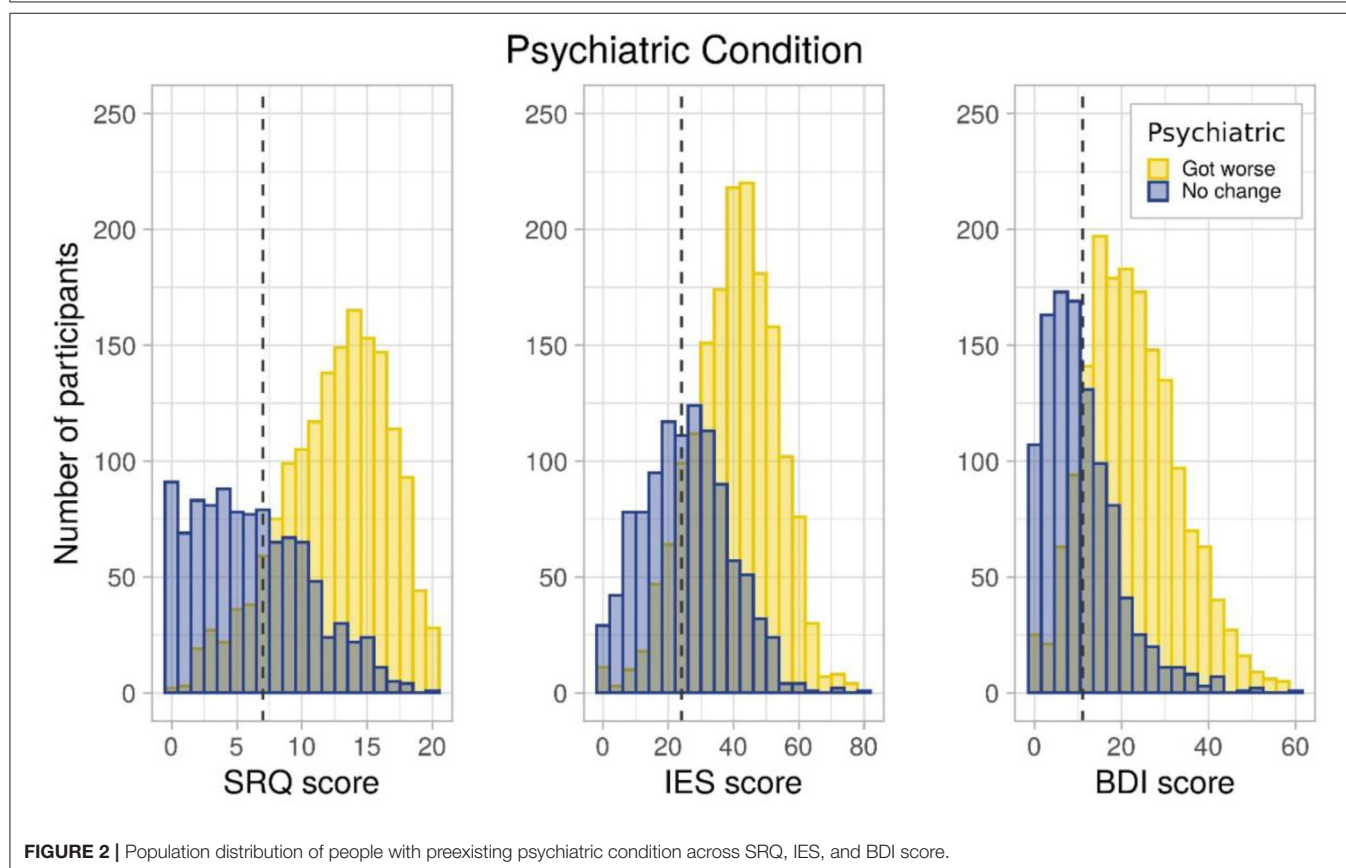


FIGURE 2 | Population distribution of people with preexisting psychiatric condition across SRQ, IES, and BDI score.

patients reporting worsening of psychiatric conditioning vs. those reporting no change. All scores were significantly ($p < 0.05$) higher in patients reporting worsening of psychiatric conditions. Distribution of patients reporting no change in their condition

in comparison to worsening along the SRQ, IES, and BDI scales further confirmed this pattern (**Figure 2**).

TABLE 1 | Association of psychiatric condition worsening and patient demographics/characteristics.

Predictors		Psychiatric condition	
		No change	Got worse
Gender	Male (<i>n</i> = 491)	51%	49%
	Female (<i>n</i> = 2,172)	36%	64%
	Non-binary (<i>n</i> = 60)	17%	83%
	Not disclosed (<i>n</i> = 21)	57%	43%
Residence	Rural (<i>n</i> = 405)	38%	62%
	Urban (<i>n</i> = 2,314)	38%	62%
Education	Compulsory (<i>n</i> = 768)	41%	59%
	Advanced (<i>n</i> = 1,955)	37%	63%
Work status	Private employed (<i>n</i> = 521)	41%	59%
	Public employed (<i>n</i> = 604)	35%	65%
	Freelancer (<i>n</i> = 201)	38%	62%
	Unemployed (<i>n</i> = 691)	35%	65%
Medical or healthcare professional	No (<i>n</i> = 2,538)	38%	62%
	Yes (<i>n</i> = 203)	38%	62%
Remotely working from home	No (<i>n</i> = 962)	40%	60%
	Yes (<i>n</i> = 1,778)	37%	63%
Opinion about employer response to COVID-19	Not satisfied (<i>n</i> = 333)	26%	74%
	Somewhat satisfied (<i>n</i> = 554)	32%	68%
	Satisfied (<i>n</i> = 886)	44%	56%
Opinion about state response to COVID-19	Not satisfied (<i>n</i> = 983)	32%	68%
	Somewhat satisfied/	42%	58%
	Satisfied (<i>n</i> = 1,757)		
Home isolation	Not isolated (<i>n</i> = 169)	50%	50%
	Individual home isolation (<i>n</i> = 314)	38%	62%
	Home isolation with family or partner (<i>n</i> = 2,263)	38%	62%
Presence of pet at home	No pet at home (<i>n</i> = 1,380)	41%	59%
	Pet at home (<i>n</i> = 1,357)	35%	65%
Interaction with family or friends	Less than usual/ Minimal interaction (<i>n</i> = 1,774)	33%	67%
	Like usual (<i>n</i> = 916)	48%	52%
Use of social media	Less than usual (<i>n</i> = 195)	31%	69%
	Like usual (<i>n</i> = 759)	53%	47%
	More than usual (<i>n</i> = 1,789)	33%	67%
Time dedicated to physical exercise	<15 min (<i>n</i> = 1,449)	37%	63%
	More than 15 min (<i>n</i> = 964)	39%	61%
	More than 1 h (<i>n</i> = 328)	42%	58%
Close person positive for COVID-19	No (<i>n</i> = 2,011)	39%	61%
	Yes (<i>n</i> = 730)	37%	63%
Close person demised due to COVID-19	No (<i>n</i> = 2,562)	38%	62%
	Yes (<i>n</i> = 182)	40%	60%
Ability to share concerns with health professional	No (<i>n</i> = 1,425)	33%	67%
	Yes (<i>n</i> = 1,133)	41%	59%
Ability to share concerns with family or friends	No (<i>n</i> = 323)	23%	77%
	Less than usual (<i>n</i> = 832)	21%	79%
	Like usual (<i>n</i> = 1,589)	51%	49%
Previous exposure to crisis	No (<i>n</i> = 1,977)	38%	62%
	Yes (<i>n</i> = 762)	40%	60%

(Continued)

TABLE 1 | Continued

Predictors		Psychiatric condition	
		No change	Got worse
Previous exposure to traumatic experiences	No (<i>n</i> = 853)	43%	57%
	Yes (<i>n</i> = 1,426)	35%	65%
	Yes, before the age of 17 (<i>n</i> = 467)	40%	60%
Personality	Extrovert (<i>n</i> = 908)	41%	59%
	Introvert (<i>n</i> = 1,682)	37%	63%
Personality	Pessimist (<i>n</i> = 685)	25%	75%
	Optimist (<i>n</i> = 798)	49%	51%
	Realist (<i>n</i> = 1,253)	39%	61%
Prediction about COVID-19 outcome/resolution	It might be the end of human race (<i>n</i> = 46)	13%	87%
	It will resolve after many months or years (<i>n</i> = 1,037)	37%	63%
	It will resolve in the summer but not within a month (<i>n</i> = 1,457)	39%	61%
Self-opinion in COVID-19 pandemic	It will resolve within a month (<i>n</i> = 159)	43%	57%
	It is not in my control at all (<i>n</i> = 157)	18%	82%
	Still some kind of control to protect myself/others (<i>n</i> = 2,580)	39%	61%

This table shows the percentage of participants with and without a worsening or their psychiatric condition divided according to their demographics/personal traits. The values are compared through an unadjusted χ^2 test, and significant differences ($p < 0.05$) are highlighted in bold font. Specifically, each bold association indicates a difference in categories reported in the predictors' column vertically.

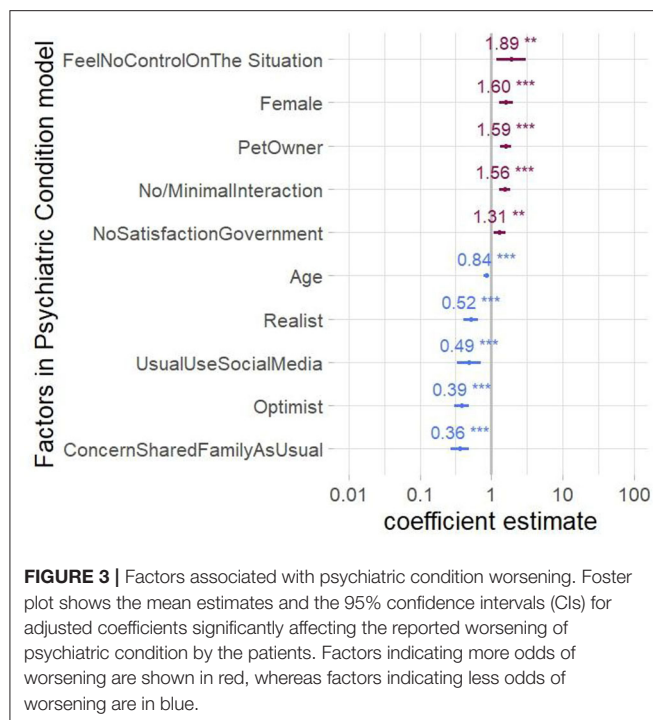
Unadjusted Analysis of the Worsening of Psychiatric Condition

Unadjusted χ^2 analysis of association between different patient factors and their report of psychiatric condition worsening revealed significantly higher reports of worsening in women, patients with advanced education, patients who reported being home isolated, and those with previous trauma exposure. Moreover, patients reporting dissatisfaction with the response of their government and employer during COVID-19 were more likely to report worsening of psychiatric condition. Finally, patients who identified themselves as a pessimist, felt lack of control during the current situation, and had negative prediction about COVID-19 resolution were more likely to report worsening of their psychiatric condition.

On the contrary, patients who were able to interact and share concerns with their family and friends or with a health professional like usual during COVID-19 were less like to report worsening of their preexisting psychiatric conditions. The details of the unadjusted categorical analysis are present in **Table 1**.

Adjusted Analysis of the Worsening of the Psychiatric Condition

Adjusted analysis was then performed for patients' report of psychiatric condition worsening via logistic regression to adjust



for confounding associations. Report of feeling no control over the situation during the COVID-19 pandemic showed an 89% increase in the odds of reporting worsening of psychiatric condition (OR, 1.89; 95% CI, 1.18–3.03). Similarly, no or minimal social interaction during COVID-19 was associated with higher odds of reporting worsening of the psychiatric condition during COVID-19 (OR, 1.56; 95% CI, 1.30–1.87). Not being satisfied with the government's response also showed an increased probability of worsening of psychiatric condition during COVID-19 (OR, 1.31; 95% CI, 1.09–1.58). Finally, female psychiatric patients were more likely to report worsening of their psychiatric condition compared to male patients (OR, 1.70; 95% CI, 1.28–2.00; **Figure 3**).

On the contrary, the ability to share concerns with family and friends like usual and optimistic attitude decreased the worsening of the psychiatric condition [OR, 0.39 (95% CI, 0.30–0.49) and OR, 0.36 (95% CI, 0.27–0.49)]. Furthermore, as-usual usage of social media during COVID-19 and considering oneself a realist also decreased the probability of worsening of psychiatric condition [OR, 0.49 (95% CI, 0.34–0.71) and 0.52 (95% CI, 0.41–0.65)].

Clinical Study

The valid clinical samples comprised 71.58% females, and the diagnosis of a vast majority (83.56%) of patients was major depressive disorder. Clinicians identified new symptoms in 44% of patients, with sleep disturbance being the most common emerging symptom. Collectively, clinicians felt the need to make treatment adjustments in almost half of the patients in the form of starting a new medication or treatment modality

or adjusting the dose of a currently prescribed medication (**Supplementary Item 3**).

Among the patient-related factors, female gender significantly increased the likelihood of a change of medication by the clinician (OR, 2.22; 95% CI, 1.03–4.49). However, other patient-related factors such as age and level of social support during home isolation were not associated with any clinical intervention (**Table 2**).

DISCUSSION

This study highlights a significant impact of the COVID-19 pandemic on psychiatric patients worldwide. At least 50% of the psychiatric patients evaluated in this study from 8 of the 12 featured countries reported worsening of psychiatric conditions. Notably, the self-reported worsening of psychiatric conditions was cross-validated with patients' scores on scales assessing general psychological disturbance, risk of PTSD, and depression. Severity of psychopathology assessed through these scales confirmed the patients' report of psychiatric condition worsening. Finally, clinician reports from an independent cohort of psychiatric patients in the United States confirmed that almost half of the patients reported new symptoms and required treatment adjustments during the COVID-19 pandemic.

In addition to ascertaining if there has been a general worsening of psychiatric conditions during COVID-19, a major aim of this study was to identify risk factors for such worsening. Female gender, having no or minimal interaction with family and friends, not being satisfied with the actions of the government, and feeling lack of control over the situation were associated with worsening of psychiatric conditions in the survey cohort. Patients who were older, considered themselves optimists or realists, used social media like usual, and were able share their concerns with family and friends during COVID-19 like usual were less likely to report worsening of psychiatric conditions. Notably, examination of the clinical cohort confirmed some of these findings. Clinicians reported significantly higher adjustment of medications for female psychiatric patients.

The results of this study confirm previous speculations and concerns about the vulnerability of psychiatric patients during the COVID-19 crisis (7, 31). Compared with previous studies on the impact of mental health during pandemic, this study focuses on the deterioration of psychiatric illnesses in response to COVID-19. Other studies have focused on vulnerable populations including indigenous, migrant, and imprisoned populations; people with disabilities; women (32); frontline workers (33); and the elderly (11), but thus far has not included populations with preexisting psychiatric illnesses. Tracing the worsening of psychiatric illnesses in response to COVID-19 can provide the insight necessary to improve mental health systems. Moreover, keeping the vulnerability of those with preexisting psychiatric illness in mind, health systems can become better equipped to address the concerns of this population, mitigate the risk of further mental deterioration, and reduce prevalence of suicidal ideation. Previous studies have reported the importance of adequate procedures to detect early mental health worsening

TABLE 2 | Factors associated with clinician change of medication.

	Change of medication
Female	2.22* (1.03–4.79)
Social Support	1.24 (0.57–2.70)
Age	0.90 (0.66–1.21)
N	291

* $p < 0.05$.

Logistic regression analysis to assess the effect of patient gender, social support during home isolation, and age predicts increased likelihood of medication change by the clinician for female psychiatric patients during the COVID-19 pandemic.

(34), but have scarcely been conducted in the context of pandemics such as COVID-19.

Identifying factors that are associated with worsening of psychiatric conditions has important implications for psychiatric prognostics and therapeutics. In our previous study, patients with prior psychiatric disease reported increased suicidal ideation (10). Understanding factors associated with psychiatric disease during a pandemic can help the patients, their family, and caregivers to screen and identify those at an increased risk of mental health crisis situations such as suicide attempts. Factors identified in this study including gender-based factors and prior exposure to trauma warrant further investigation to ensure that health systems can provide for the needs of a vulnerable population.

Previous research also shows increased gender-based disparity in association with humanitarian crises (35). During the Ebola outbreak of 2014–2016, women were reported to be at an increased risk of abuse, violence, and a lack of access to protective instructions (32). Moreover, women are more susceptible to the effects of economic insecurity, social isolation, disaster-related unrest, reduced health service accessibility, inability to escape abusive partners, and violence against healthcare workers. Measures such as social isolation have increased women's exposure to domestic violence: early reports from a police station in China's Hubei Province revealed three-times increased domestic violence targeting women during the COVID-19 quarantine period of February 2020 (32).

There are several strengths of our global and immediate approach to the examination of the vulnerable population of psychiatric patients during COVID-19. First, the sample size is large. Second, to reduce the participation bias, the study was administered in 11 different languages, ensuring generalizability across countries and cultures. Participants from the 12 countries represented a diverse perspective according to the economic structure and government support provided by their respective countries. For instance, countries such as Canada, France, Germany, Italy, Spain, Switzerland, and United States are classified as high-income economies according to the World Bank Atlas, whereas Bosnia and Herzegovina, Iran, Pakistan, and Turkey are considered middle- or lower-income countries (36). Third, as one of the earliest examinations of the mental health impact of COVID-19, our study carries the unique strength of immediate data collection during the peak of the COVID-19 pandemic in North America and Europe. In both the

online survey and the clinical design, the psychiatric conditions were present in the patients at the baseline and thus indicate the potential effect of the pandemic on worsening of these conditions. Finally, the objective assessment of worsening of psychiatric conditions by the clinicians in the independent clinical cohort is an important contribution and strength of this study.

This study also has potential limitations that warrant consideration while interpreting the results. First, the sampling method is nonrandomized for the survey cohort. While a nonrandomized approach has potential disadvantages, we hope that the results of this study can nonetheless serve as a resource and catalyst for further investigation. For a similar global or continent-wide study, entities such as the WHO and the EU (European Union) could develop and administer a similar study with a wider reach. Second, the data were exclusively collected online for the survey—this may have excluded those less well-versed in web usage such as underdeveloped, rural, or disadvantaged populations. Nevertheless, to counter existing language barriers that may compound computer illiteracy, we translated the survey in native and official languages for each of the featured countries. Another important consideration is a potential confounding effect of other important factors, such as duration and severity of preexisting psychiatric conditions that may influence the impact of the current stressful events (37). Furthermore, quality of mental health services and mental health literacy could play an important role in mediating or modulating the effects of the pandemic on neuropsychiatric functioning of patients. Indeed, this could explain the regional differences in patient reports of psychiatric condition worsening. Lastly, a longitudinal assessment of the evolution of psychological symptoms in response to the COVID-19 pandemic is imperative and is the subject of an ongoing investigation by our group.

In conclusion, this effort highlights a significant impact of the COVID-19 pandemic on the mental health of psychiatric patients and elucidates prominent associations with their demographics, household conditions, personality traits, and attitude toward COVID-19. These results could serve to inform mental health professionals and policymakers across the globe, aiding in dynamic optimization of mental health services during and following the COVID-19 pandemic, and reducing its long-term morbidity and mortality.

DATA AVAILABILITY STATEMENT

The datasets generated in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: All data presented in the main and **Supplementary Items** are deposited on the repository below and are available for verification upon request. https://osf.io/3vupe/?view_only=80f71b6f0c8d49b08573ea12eab10d33.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Zurich Cantonal Ethics Commission, Zurich,

Switzerland Medical Faculty of the University of Tuzla, Tuzla, Bosnia Nencki Institute of Experimental Biology, Warsaw, Poland. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

SG and MP contributed in conceptualization, questionnaire development, data collection, data mining, data analysis, visualization, review, and editing. ZA contributed in data collection, manuscript writing, review, and editing. BS, SL, KA, AD, AB, LH, SE, HJ, LR-P, VW, AAL, MB, and DS contributed in questionnaire translation, data collection, data mining, review, editing, and project co-ordination. PR contributed in data analysis and visualization. RN contributed in data collection, manuscript writing, review, and editing. ZB-T contributed in data analysis. ZH, AAR, and SQ contributed in clinical data collection and project co-ordination. AJ contributed in conceptualization, questionnaire development, study approval, data collection, data analysis, data visualization, manuscript writing, review, editing, project administration, and supervision. All authors contributed to the article and approved the submitted version.

FUNDING

AJ is supported by an International Research Agenda (MAB) grant by Foundation for Polish Science (FNP).

ACKNOWLEDGMENTS

We gratefully acknowledge the contribution of Luciana Armengol (Argentina), Prof. Anthony Hannan, Maxine Mason, Qi Hui Poh (Australia), Taria Brkić (Bosnia and Herzegovina), Barbara Levinsky (Brazil), Alexandra Schimmel and Lea Caya-Bissonnette (Canada), Claudia Valenzuela Rios

(Chile), Marc Scherlinger, Alice Tondre, Lola Kouroma, and Morgane Roth (France), Katharina Schlerka, Lisa Garrelts, and Romy Seifert (Germany), Lena Heck (Germany/Switzerland), Varsha Hooda, Deepak Tanwar, and Chakradhar Yakkala (India), Prof. Mohammad Es hagh and Sepehr Namirad (Iran), Darren Kelly (Ireland), Nour Mosawy (Jordan), Dayra Lorenzo (Mexico), Chirine Katrib (Lebanon/France), Usman Mukhtar, Uzair Jaswal, and Mubaris Bashir (Pakistan), Prof. Kornelia Kedziora-Kornatowska, Milena Czarnocka and Juli Davis (Poland), Ana Alexandra Moraru (Romania), Shoaib Jawaaid (Saudi Arabia/United Arab Emirates), Myriam Merarchi (Singapore/France), Michelle McLuckie, Doman Obrist, Niharika Gaur and Graciela Huber (Switzerland), Aurelia Muller (Taiwan/Germany/Switzerland), Burak Ozan (Turkey), Carmen Neagoe and Aleena Malik (UK), Anastasiia Timmer (Netherlands/United States), Colette Rausch, Prof. Paul Schulz, Prof. Mo Salman, Saleha Tahir, Laura Luebbert, Sarish Khan, Rebecca Sager, Lupita Lozano, and American Physician Scientist Association (United States) for their dedicated help in data collection. We are also thankful to Lena Heck and Giuseppe Parente (University of Zurich) for technical support. Finally, we would like to express our gratitude to Prof. Selmira Brkić (Faculty of Medicine, University of Tuzla, Bosnia and Herzegovina), Prof. Leszek Kaczmarek (Director, Nencki-EMBL BrainCity, Warsaw, Poland), University of Zurich Research Office, Zurich Cantonal Ethics Commission, Texas Behavioral Health, and European MD-PhD Association for their expedited review of the study procedures under extra-ordinary circumstances and for their organizational support. This manuscript has been released as a pre-print at Medrxiv (38).

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2020.581426/full#supplementary-material>

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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“Psychological Antibodies” to Safeguard Frontline Healthcare Warriors Mental Health Against COVID-19 Pandemic-Related Psychopathology

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Keywords: psychological antibodies, COVID-19 pandemic, psychopathology, psychological immunity, frontline healthcare warriors

OPEN ACCESS

Edited by:

Carlo Lai,
Sapienza University of Rome, Italy

Reviewed by:

Laura Orsolini,
University of Hertfordshire,
United Kingdom

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 31 July 2020

Accepted: 13 November 2020

Published: 18 December 2020

Citation:

Jaiswal A, Singh T and Arya YK (2020)
“Psychological Antibodies” to
Safeguard Frontline Healthcare
Warriors Mental Health Against
COVID-19 Pandemic-Related
Psychopathology.
Front. Psychiatry 11:590160.
doi: 10.3389/fpsy.2020.590160

The rapid and unprecedented worldwide spread of the novel coronavirus, also termed as 2019 novel coronavirus (2019-nCoV) or 2019 coronavirus disease (COVID-19), has immensely strained the existing healthcare systems (HCSs) throughout the world (1). The frontline healthcare workers (HCWs) (doctors, nurses, paramedics, ambulance personnel) are occupied with the direct diagnosis, treatment, and care of the COVID-19 infected patients and hold the significant responsibility of flattening the pandemic growth curve and reducing the infection fatality rate. Though HCWs would have their Behavioral Immune System continuously active during this pandemic situation (2), excessive workload, the risk of nosocomial transmission, lack of essential resources and specific medical treatment, and frequent encounters with trauma and death have heightened their risk of psychological distress (3) and trauma (4); psychopathology, such as substance use (2); mood disorders, such as insomnia, anxiety, and depression (3); delusional episodes; suicidality (4); and even suicide (5, 6). An eventual rise in the need of mental health services by HCWs is probable as these mental health consequences may remain even after the pandemic remits (7, 8). As the medical professionals are the most significant assets in countering the pandemic, safeguarding the physically and emotionally exhausted (9) HCWs' mental health becomes significant. This opinion article briefly describes the psychopathology encountered by HCWs during the 2019-nCoV pandemic and the protective role “psychological antibodies” constituting the psychological immunity (PI) can have in guarding HCWs against these psychopathological symptoms. Particular attention is drawn toward the need for developing evidence-informed individual- and organizational-level PI-boosting interventions for HCWs.

COVID-19-LINKED PSYCHOPATHOLOGY IN HCWs

The medical personnel attending the COVID-19 patients report significantly higher symptoms of somatization, obsession, compulsion, anxiety, phobic anxiety, and psychoticism. Besides, they have significantly lower interpersonal sensitivity and overall poor mental health (10). HCWs also suffer emotional disturbances, such as anxiety and depression, excessive workload, physical and mental exhaustion, burnout, post-traumatic stress symptoms, loneliness, sleep disorders, and distress (3, 11–17). The fear of getting infected and having a sudden role reversal from a healthcare provider to a medical patient leads to the feelings of frustration and helplessness, adjustment issues, perceived stigma, and fear of discrimination (18). HCWs are performing duties outside of perceived skills, experiencing life threats, and witnessing co-worker's serious illness, injury, and death (19), all

of which are specific factors that put them at a higher risk for developing post-traumatic stress disorder (PTSD) a few months later (20). A timely systematic review and meta-analyses provided evidence that a considerable fraction of HCWs experienced significant levels of anxiety, depression, and insomnia during the coronavirus pandemic (21). The frontline HCWs in the department of respiratory medicine, emergency, intensive care unit (ICU), and infectious disease have 2-fold chances of experiencing anxiety, depression, and other mental health problems compared with the non-clinical staff (15, 22, 23). The infection rate among medical staff (24), fear of infection to colleagues and family, protective measures, and medical violence further add to HCWs' psychological issues (25). These mental issues can potentially lead to medical treatment errors, patient mortality, substance abuse, and even suicidal ideation among HCWs. Thus, "Healing the Healer" (26) becomes crucial. In addition to these potential hazards that exceed the consequences of COVID-19 itself (27), the accumulated psychological pressure and the intense fear of death during the pandemic even pushed the already vulnerable medical professionals into committing suicide (5, 6). Though researchers (9, 17, 22) indicate a need for effective strategies, mental health informed interventions, and regular intensive training for HCWs, evidence-based evaluations and potential mental health interventions targeting frontline HCWs are relatively scarce (3, 28). Further, till date, neither any clinician-administered scale for measuring psychological distress or disorders in the COVID-19 context (29) nor any specific recommendations from the international bodies on the addressal of the mental health concerns during the pandemic are available (30). Identifying the personal resilience resources that mitigate stress can aid in the rapid design of evidence-informed individual- and organizational-level interventions for HCWs.

PSYCHOLOGICAL ANTIBODIES AND THE PSYCHOLOGICAL IMMUNE SYSTEM

The concept of the Psychological Immune System (PIS) was proposed by Olah (31) to integrate the isolated but empirically correlated character strengths and stress-resistant resources of the personality into one comprehensive system. PIS is a multidimensional yet integrated unit of personal resilience resources and adaptive capacities, also referred to as "psychological antibodies" (32), that provide immunity against damage, stress (33), and traumatic events (34). **Table 1** briefly describes the three subsystems entailed in the PIS and their respective psychological antibodies. During the coping process, these subsystems dynamically interact and regulate one another's functioning and guide the person to use flexible and self-developing coping strategies (35, 36).

PSYCHOLOGICAL IMMUNITY: A COUNTER TO COVID-19-RELATED PSYCHOPATHOLOGY

Prior studies assessing psychological immunity (PI) protective potentials (psychological antibodies) in high-stress occupation

personnel, such as emergency nurses (37), medical professionals (32), and military soldiers (38), have yielded promising results. PI holds a strong positive correlation with life satisfaction and well-being dimensions (environmental mastery, purpose in life, personal growth, self-acceptance, positive relations, and autonomy) and a negative correlation with burnout (33). The antibodies, sense of control (SOC), sense of self-growth, synchronicity, impulse, emotion, and irritability control are strongly correlated with mental and physical health (33). Positive thinking, SOC, and sense of self-growth mediate the psychological adjustment–mental health linkage in instances of acute psychopathology (39). The personality resources comprising PIS significantly predict the level of satisfaction in gymnasts (40). Approach-Belief Subsystem (ABS) and Monitoring–Creating–Executing Subsystem (MCES) correlate positively with the hope of attaining goals, and the entire PIS correlates positively with life satisfaction and negatively with depression (41). There also exists a strong correlation between PI and life expectancy (42).

PI, and the psychological antibodies therein, can provide HCWs effective coping against stress and guard them against psychopathology. Positive thinking educational intervention and training via social media reduce nurses' job stress (43) and enhance their quality of work-life (44). It is plausible as positive thinking entails optimism and hopefulness, which influence the primary appraisal process and the perception of person-situation transactions. While low job control associates with increased sickness absence in hospital physicians (45), control over work and significant levels of autonomy bear a protective effect on mental health (46, 47). A study on female nurses found that SOC is a protective factor for depressive state, burnout, and job dissatisfaction and can be a health-promoting resource (48). A sense of self-growth promotes openness and assimilation of the new experiences and strongly motivates self-actualization and self-expansion. Personal growth has significant association with role boundary, role insufficiency, role ambiguity, and interpersonal, psychological, and physical strain (49). Thus, the HCSs shall maintain an increased workforce and ensure that their HCWs have well-defined duties, shorter working periods, flexible schedules, shift duties, regular breaks, and supervisor support. Studies with HCWs have shown that self-concept underlies the development of the professional self-concept (50). Hence possessing a high creative self-concept will enable HCWs to bear a positive outlook and success orientation toward most situations they encounter. Contrarily, a low level of self-efficacy in HCWs during the 2019-nCoV pandemic associates with heightened stress, anxiety, depressive symptoms, and insomnia (24) and is a risk factor for loneliness (51). A study on emergency room (ER) nurses found that goal orientation explains considerable variance in burnout and work engagement, with mastery-approach goal orientation being particularly beneficial (52). Health professionals using problem-solving-related strategies and positive re-assessment do not report any health problems and have a better emotional state than those employing other coping strategies (53). Challenge orientation negatively predicts burnout and secondary traumatic stress (compassion fatigue) in palliative care nurses (54). Thus, promoting this antibody can

TABLE 1 | Subsystems of the psychological immune system, their respective antibodies, and practical recommendations for enhancing healthcare workers' psychological immunity.

PIS	Psychological antibodies	Description	Practical recommendations
Approach-Belief Subsystem (ABS) (it guides an individual's orientation toward the environment)	Positive thinking	It involves cognitive personality dimensions facilitating the anticipation of positive outcomes in circumstances outside one's control.	- Stay optimistic and hopeful. - Practice some form of positive ideation pertaining to the current and upcoming circumstances.
	Sense of control	It is a sense of personal influence or perceived control over life events.	- Believe in your ability to change or modify your everyday occurrences and outcomes. - Do not attribute your failures to luck or chance factors.
	Sense of coherence	It is the belief that life is understandable, comprehensible, and manageable.	- Believe that the environment is predictable and the occurrences therein are manageable.
	Sense of self-growth	It is a stable conviction that one can continuously overachieve and enhance their personality and personal productions.	- View every circumstance as a growth-inducing experience that further nourishes your personality and productivity.
Monitoring-Creating-Executing Subsystem (MCES) (it initiates the search for information and puts into action the resources necessary to influence and create possibilities within the environment)	Creative self-concept	It is an individual's strong belief in their creative power, self-worth, and the worth of their life accomplishments.	- View difficult and unprecedented circumstances from a novel perspective and come up with creative solutions. - Maintain a high sense of self-worth. - Try to become a resourceful person.
	Self-efficacy	It is the ability to expect that one can act in the way required to produce the desired outcomes.	- Continually upgrade your knowledge and medical skills. - Hold confidence in your abilities.
	Goal orientation	It is the ability to maintain motivation and endurance in accomplishing tasks even in the face of adversities and obstacles.	- Develop intrinsic motivation towards tasks. - Remain enduring while completing any task howsoever challenging or tricky it appears.
	Problem-solving capacity	It is the ability to reconstruct and reorganize learned experiences to create new ideas and plans and execute alternative solutions for handling problems and difficulties.	- Enhance your innovative ability. - Indulge in constructive thinking.
	Change and challenge orientation	It involves openness to novel experiences, intrinsic motivation to explore the environment, sensitive perception following changes, and anticipation of change as adaptive, challenging, and positive.	- Do not refrain from novel circumstances. - Anticipate changes as adaptive and/or positive rather than as threats.
	Social monitoring capacity	It is the sensitive and selective observation and use of social or environmental information for achieving future aims.	- Develop mindful awareness. - Form interpersonal connections. - Develop empathetic ability. - Enhance your emotional intelligence.
	Social mobilizing capacity	It is the ability to motivate, force, govern, and direct human resources to benefit one's aims.	- Develop leadership abilities, communication skills, and social assertiveness.
	Social creating capacity	It is the ability to create social resources in situations where their existence is inevident.	- Stay vigilant about others' skills and talents. - Develop teamwork spirit.
Self-Regulating Subsystem (SRS) (it stabilizes emotions and ensures the functioning of the preceding subsystems)	Synchronicity	It is the ability to be "in flow" with the current environment or task and maintain a maximal concentration on personal and environmental issues.	- Practice mindfulness and try to maintain mindful attention. - Learn the skills (e.g., avoidance) needed to disengage from the distracting conditions.
	Impulse control	It is the ability to manage behavior by rational control over spontaneous actions.	- Control your impulsive reactions and behavior. - Orient yourself toward rational and reflective actions. - Thoroughly contemplate on any decision before acting on it.
	Emotion control	It is the ability to regulate the negative feelings and emotions (e.g., worry, anxiety, depression, etc.) induced by anticipation of failure.	- Do not carry the baggage of past setbacks or failures. - Instead of denying, accept your negative feelings and emotions.
	Irritability Control	It is the ability to control and constructively regulate impatience and anger stemming from unsatisfied essential needs.	- Do not lose your temper easily. - Develop frustration tolerance.

help reduce psychological distress and burnout in HCWs. Those with high social monitoring, mobilizing, and creating capacities have openness for contact with people, are socially assertive,

and possess communication abilities. HCWs display reluctance to participate in the psychological interventions developed for them (55). Promoting these antibodies will benefit in inhibiting

their hesitance to seek help or discuss their problems with a counselor or mental health professional. Synchronicity, impulse, emotion, and irritability control regulate emotions and prevent any emotional dysregulation or dissonance. The COVID-19 pandemic has made HCWs prone to emotional disturbances, vicarious trauma, and irritability (56, 57). Enhancing these antibodies, incredibly emotion and irritability control, in HCWs will enable them to use their frustration and anger constructively.

Table 1 provides some practical recommendations that can assist the HCWs in enhancing their PI and the intervention developers in designing effective PI-boosting interventions for HCWs. The medical workers with higher mental health problems report poor self-perceived physical health as well. Contrarily, the access to psychological aid (materials/ resources) is inversely

related to the proportion of mental health problems (58). With this in view, researchers indicate the need for regular screening and timely addressal of psychological health concerns among HCWs, preferably through psychotherapeutic means (14, 59). As PI can be modified by psychotherapeutic interventions (34), developing evidence-informed, tiered, and tailored PI-boosting interventions will help protect the “protectors” from being victimized by the pandemic.

AUTHOR CONTRIBUTIONS

YA, AJ, and TS conceptualized the theme and prepared the final manuscript draft. AJ wrote the first draft. TS and YA reviewed and commented on the initial draft. All authors contributed to the article and approved the submitted version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Comparing the Impact of COVID-19-Related Social Distancing on Mood and Psychiatric Indicators in Sexual and Gender Minority (SGM) and Non-SGM Individuals

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OPEN ACCESS

Edited by:

Andreas Maercker,
University of Zurich, Switzerland

Reviewed by:

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University Hospital Zürich, Switzerland
Andres Ricardo Schneeberger,
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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 01 August 2020

Accepted: 19 November 2020

Published: 22 December 2020

Citation:

Rodriguez-Seijas C, Fields EC, Bottary R, Kark SM, Goldstein MR, Kensinger EA, Payne JD and Cunningham TJ (2020) Comparing the Impact of COVID-19-Related Social Distancing on Mood and Psychiatric Indicators in Sexual and Gender Minority (SGM) and Non-SGM Individuals. *Front. Psychiatry* 11:590318. doi: 10.3389/fpsy.2020.590318

Empirical evidence demonstrates mental health disparities between sexual and gender minority individuals (SGM) compared with cisgender heterosexual individuals. SGM individuals report elevated rates of emotional distress, symptoms related to mood and anxiety disorders, self-harm, and suicidal ideation and behavior. Social support is inversely related to psychiatric symptoms, regardless of SGM status. The COVID-19 pandemic—with its associated limited social interactions—represents an unprecedented period of acute distress with potential reductions in accessibility of social support, which might be of particular concern for SGM individuals' mental well-being. In the present study, we explored the extent to which potential changes in mental health outcomes (depressive symptoms, worry, perceived stress, positive and negative affect) throughout the duration of the pandemic were related to differences in perceptions of social support and engagement in virtual social activity, as a function of SGM status. Utilizing a large sample of US adults ($N = 1,014$; 18% reported SGM status), we assessed psychiatric symptoms, perceptions of social isolation, and amount of time spent socializing virtually at 3 time windows during the pandemic (between March 21 and May 21). Although SGM individuals reported greater levels of depression compared with non-SGM individuals at all 3 time points, there was no interaction between time and SGM status. Across all participants, mental health outcomes improved across time. Perceived social isolation was associated with poorer mental health outcomes. Further, time spent engaging in virtual socialization was associated with reduced depression, but only for those in self-reported quarantine. We discuss these results in terms of the nature of our sample and its impact on the generalizability of these findings to other SGM samples as well as directions for future research aimed at understanding potential health disparities in the face of the COVID-19 pandemic.

Keywords: COVID-19, gender, sexual orientation, well-being, depression, social isolation, mood

INTRODUCTION

The Coronavirus Disease 2019 (COVID-19) pandemic is unprecedented in most of our lifetimes and has had far reaching effects worldwide. At the time of this publication, we are only beginning to grasp the full extent of this international public health crisis. With this unique time in human history comes the realization that we have little understanding of the differential impact of large-scale public health measures being implemented. While there has necessarily been focus on the physical health implications of the pandemic, it is becoming increasingly clear that there are important mental health repercussions that are only beginning to be understood (1). Worse mental health outcomes have been reported as a direct function of COVID-19 infection [e.g., (2)] as well as due to indirect distress related to the pandemic [e.g., (3, 4)]. Apart from the general distress related to the COVID-19 virus itself and potential morbidity, psychosocial disruptions and alienation resultant from measures designed to contain the spread of the disease hold the potential to further compromise mental health through curtailed opportunities to engage in social activities. Further, these deleterious effects might not universally affect all persons in equal magnitude.

Sexual and gender minority (SGM) individuals—those reporting sexual orientation and gender identity other than heterosexual and cisgender—represent one population likely to be disproportionately impacted by COVID-19 and public health responses to the disease. SGM individuals typically experience higher rates of poverty (5), housing instability (6), food insecurity (7), lack of healthcare insurance (8), and employment within industries negatively affected by and with higher infection potential (9) compared with their cisgender heterosexual counterparts. Independent of the COVID-19 pandemic, a robust literature documents psychosocial health disparities between SGM and cisgender heterosexual individuals. When compared with cisgender heterosexual individuals, SGM persons demonstrate higher prevalence of mood and anxiety disorders, suicidal ideation and behavior, as well as problematic substance use (10–19). Further, psychosocial health disparities observed among SGM populations exert a synergistic effect in the ways in which they compromise SGM well-being (20, 21). These health disparities are largely driven by minority stress processes (22–24); sexual and gender minority-based stressors operate in direct and indirect ways to compromise well-being (25, 26). Stigma and discrimination against SGM individuals, especially for those with intersecting marginalized identities, have contributed to barriers in accessing healthcare, employment, and other socioeconomic resources. The global public health response to the COVID-19 pandemic might potentiate psychosocial threats to mental health among SGM individuals (8).

Social support promotes well-being. Conversely, social isolation compromises health (27). Perceived social support attenuates the impact of stressful life events on psychological distress (28–31) and is negatively associated with depressive symptoms specifically (32–35), as well as psychiatric distress more generally (6). Empirical evidence further documents the importance of social support for SGM individuals' mental health. Perceptions of support from family and friends are negatively

associated with mental health (36–39) outcomes. Social support not only directly impacts mental health, but also indirectly through engagement in effective behavioral coping mechanisms (40, 41).

However, SGM individuals experience greater social isolation and less social support than their cisgender heterosexual peers (42, 43). The importance of social support for SGM individuals' health is reflected in an explicit focus on facilitating supportive relationships in evidence-based treatment of SGM individuals' psychosocial health (44–46). Emerging literature further highlights the importance of social support for navigating COVID-19-related distress. For example, in one study (3), adults in Egypt reported seeking increased support from friends and family members in response to the pandemic. Additionally, data from Italian adults in high- and low-contagion regions demonstrates the buffering effects of both in-person and virtual social support on psychiatric distress symptoms (47). Facing increased social exclusion and marginalization at a population level alongside worse group-based mental health outcomes, resultant from minority stress, when compared with cisgender heterosexual individuals, it is possible that social restrictions aimed at containing the spread of COVID-19 might disproportionately compromise the mental health of SGM individuals.

The goal of the current study was to compare the impact of (1) nationwide business closures and stay-at-home orders at the onset of the United States response to the COVID-19 pandemic, (2) perceptions of social isolation and time spent engaging in virtual socializing activities, and (3) the interrelatedness of these variables on ratings of mood, depressive symptoms, worry, and perceived stress between SGM and cisgender heterosexual individuals. As preregistered at <https://osf.io/kg6bu>, we hypothesized that SGM individuals will report increased symptoms of psychiatric distress at the start of the assessment period when compared with cisgender heterosexual individuals. Further, we predict that the disparity would become exacerbated over the course of the assessment period. We also hypothesize that perceptions of social isolation will be positively associated with, and reports of time spent socializing virtually will be negatively associated with, mental health outcomes across time, and that this relationship will be stronger for SGM individuals (i.e., social support will be more impactful for SGM persons than cisgender heterosexual individuals).

METHODS

Participants

As part of a larger, ongoing study exploring the mental health repercussions of the COVID-19 pandemic and response measures, online recruitment for this report began on March 20, 2020. During the course of the recruitment period, $N = 1,930$ participants completed the online informed consent and were enrolled in the study. Of this initial recruitment, $N = 1,462$ completed the initial demographic survey, which was required before daily surveys began. Of this total sample, $n = 1,171$ reported cis-gender identity and heterosexual sexual orientation

and $n = 291$ reported SGM status (19.9% of total sample). As the time course of the spread and response measures to COVID-19 differed by country, here we only included participants in our study from the United States (cisgender heterosexual $n = 833$; SGM $n = 181$) to minimize the variability in timelines. All English-speaking adults 18+ from anywhere in the world were eligible for the study, regardless of pre-existing mental health or medical conditions. Only study personnel were ineligible for participation. Recruitment relied primarily on contact with previous participants, dissemination through professional networks, social media, and word of mouth. The age of participants in this sample ranged from 18 to 90 years old ($M = 36.7$, $SD = 16.0$). See **Table 1** for additional demographics. Compensation for participation was in the form of raffle entries for gift cards. The Boston College Institutional Review Board approved all consent and assessment procedures.

Assessment Materials

Demographic Survey

Immediately after consenting, participants were sent an initial demographic survey. Completion of this survey was required before receiving any further assessments. Participants self-reported natal sex, current gender identity, sexual orientation, race/ethnicity, age, socioeconomic status, marital status, military status, education level, number of dependents, and whether or not they had ever received a previous diagnosis of a serious mental health and medical condition. Congruent with the previous literature documenting higher psychiatric disorder prevalence among SGM compared with non-SGM populations, 51% of the SGM sample reported being previously diagnosed with a serious mental health condition compared with 26% of the non-SGM sample. However, there were high rates of missingness in the dichotomous previous mental health diagnosis variable. Fifty-two percentage of SGM and 49% of non-SGM persons did not provide information on previous mental health disorder diagnoses. The demographic survey questions used for all participants can be found here: <https://bit.ly/BC-DEMOS>.

Daily Survey

After completion of the Demographic Survey, participants were immediately enrolled to begin receiving daily assessment surveys. Two versions of our daily survey were utilized throughout the duration of the assessment period: a Short Version and a Full Version. The Short Version was created to reduce participant burden during the longitudinal study design. Relevant to this report, the Short Survey included questions of subjective experience of stress, time spent virtually socializing, and perception of being under quarantine. The question on subjective experience of stress was reported on a 7-point Likert scale, time spent virtually socializing, and perception of being under quarantine was a binary “yes/no” response. All questions within the Short Version of the survey were optional and participants were asked to respond to any that they were able to, given their time and energy on the day it was received.

The Full Version of the survey included all questions from the Short Version, as well as measures of mood using the Positive and Negative Affect Schedule (48), subjective experience of worry

related to COVID-19, subjective perception of social isolation, and symptoms of depression using a modified version of the Patient Health Questionnaire-9 [PHQ-9; (49)] that omitted the question assessing suicidality. The questions on perception of social isolation and COVID-related worry questions (assessing domains of individual health, family/friend health, community health, national health, financial impact) were reported on 7-point Likert scales. To assess overall worry we created a Worry Composite by summing the responses to all worry questions. The PANAS metrics of positive and negative affect were scored as recommended. The eight remaining PHQ-9 questions were summed as a modified depression score (referred to as “depression” in the results). Most questions within the Full Version were required in order for the form to be submitted, but participation was always optional each day it was received.

Participants were instructed not to try to make up surveys on days that they missed. A view of the Full Version survey questions (that also contains all questions of the Short Version) can be found here: <https://bit.ly/BC-FullVersion>.

Study Design

Data collection procedures are discussed in detail in our pre-registration (<https://osf.io/kg6bu>). Briefly, enrollment in this study opened on March 20, 2020. After participants completed the online consent form, they received the Demographic Survey. After completion of the demographic survey, they were then enrolled to receive the Daily Surveys for the duration of the assessment period. Participants received either the Short or Full Version of the daily survey each day of the assessment period (until May 20) following their enrollment. To establish a baseline of mental wellbeing, participants received the Full Survey for the first three days following completion of the demographics. The Full Survey was then sent randomly 2 days/week, with the Short Survey sent the remaining 5 days/week. As such, the questions of subjective experience of stress, time spent virtually socializing, and perception of being under quarantine were administered every day of the assessment period, while collection of PANAS positive scale, PANAS negative scale, COVID-related worry questions, subjective social isolation, and the modified PHQ-9 scale occurred twice a week. Although this study is part of a larger study that includes additional planned follow-up assessments, the daily survey data collection ended on May 20, 2020 for all participants. See **Figure 1** for a schematic of the study timeline.

Data Analysis

As described in our pre-registration (<https://osf.io/kg6bu>), to test our hypotheses, we averaged across all responses for each participant in each time bin (early: March 21st–April 3rd; middle: April 14th–April 27th; late: May 7th–May 20th) for each dependent variable. These time bins were used to create periods of equal duration that were equidistant apart throughout the daily assessment period. The averaged variables were analyzed with linear mixed models with a random intercept for the subject. Each dependent variable of interest was analyzed in a separate model with SGM status and time bin as categorical predictors (Model 1). Average responses to self-reported social isolation and time spent virtual socializing within each time bin were then

TABLE 1 | Demographics of SGM and non-SGM samples.

	ALL	Non-SGM	SGM
N	1,014	833	181
Age			
Mean	36.65	37.96	30.62
Standard deviation	15.96	16.54	11.19
Minimum	18	18	18
1st Quartile	26	26	23
Median	31	31	28
3rd Quartile	42.75	46	34
Max	90	90	83
Ethnicity			
Hispanic	6%	6%	5%
Not Hispanic	93%	93%	93%
Prefer not to say	1%	1%	1%
Race			
African American	2%	0%	3%
Asian	8%	9%	8%
White	81%	81%	81%
Hispanic/Latinx	2%	3%	2%
Native Hawaiian or Other Pacific Islander	0%	0%	0%
American Indian/Alaska Native	0%	1%	0%
More than one race/Prefer to self-describe	6%	6%	6%
Unknown	0%	0%	0%
Prefer not to say	0%	0%	0%
Gender			
Female	81%	82%	76%
Male	18%	18%	16%
Non-binary/third gender	1%	0%	7%
Other	0%	0%	1%
Biological Sex			
Female	82%	81%	85%
Male	18%	19%	15%
Gender Identity			
Cisgender	99%	1.00%	94%
Transgender	1%	0%	4%
Unknown	0%	0%	2%
Sexual Orientation			
Straight	82%	100%	1%
Bisexual	12%	0%	70%
Gay	3%	0%	19%
Other	2%	0%	11%
Education			
Some high school	0%	0%	1%
High school diploma/GED	2%	2%	3%
Some college	14%	13%	19%
Bachelor's degree	28%	29%	25%
Some post-graduate	11%	11%	11%
Post-graduate or professional degree	45%	45%	41%
Marital Status			
Single	33%	31%	43%
In a relationship	26%	25%	31%

(Continued)

TABLE 1 | Continued

	ALL	Non-SGM	SGM
Married	34%	36%	24%
Divorced/separated	5%	5%	3%
Widowed	2%	3%	0%
Serious Medical Problems			
No	92%	93%	90%
Yes	8%	7%	10%
Income			
\$0–25,000	8%	7%	12%
\$25,001–50,000	14%	12%	23%
\$50,001–75,000	18%	18%	18%
\$75,001–100,000	16%	17%	14%
\$100,001–150,000	20%	20%	15%
\$150,001–250,000	15%	16%	12%
\$250,000+	9%	10%	7%
Student			
No	76%	78%	69%
Yes	24%	22%	31%
Employed			
Yes	79%	79%	80%
No	21%	21%	20%

All age metrics reported are in "years." All other measures are reported as the percentages of each group (All, SGM, non-SGM) that identify as each demographic variable.

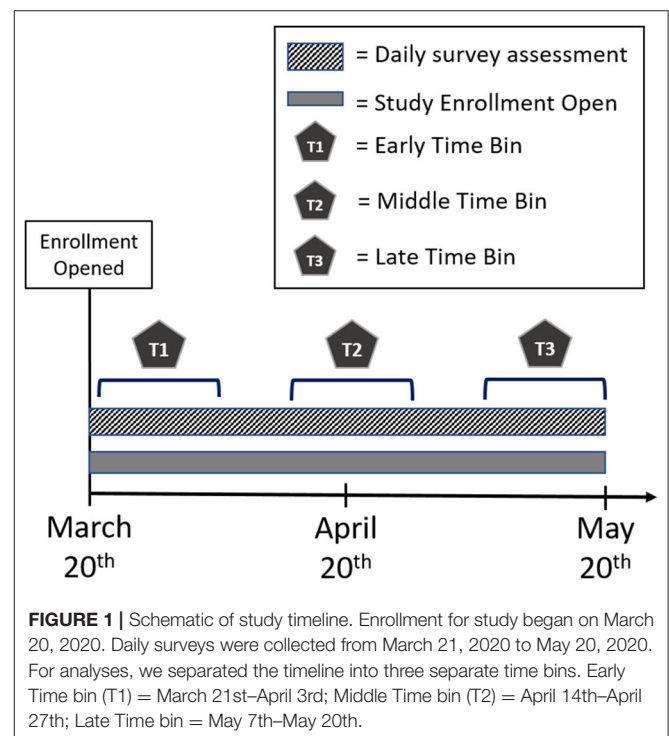


FIGURE 1 | Schematic of study timeline. Enrollment for study began on March 20, 2020. Daily surveys were collected from March 21, 2020 to May 20, 2020. For analyses, we separated the timeline into three separate time bins. Early Time bin (T1) = March 21st–April 3rd; Middle Time bin (T2) = April 14th–April 27th; Late Time bin = May 7th–May 20th.

calculated and added to the models to determine the impact of perceived social isolation (Model 2) and virtual socialization (Model 3) on the relationship between SGM status and time for

each metric of mental well-being. For Model 4, responses to each dependent variable of interest were analyzed separately across days that participants reported being under quarantine and days that they were not (ignoring time bin), making quarantine and SGM status categorical predictors for the model. Further, time spent virtually socializing was added to the model to determine the differential impact of socializing virtually on our metrics of mental well-being for participants that reported being under quarantine and those that were not.

Because there was a notable difference in the distribution of age across the SGM and non-SGM groups, all models included age as a covariate. This is particularly important in light of previous analyses on this dataset that determined strong effects of age on most of the reported dependent variables (see <https://osf.io/tb4qv>). Main effects of age are reported here, but discussed elsewhere (Cunningham et al., in revision). Further, for all models using virtual socialization, the amount of time that participants spent virtually socializing was log (base 2) transformed before being entered into regression models. This reflects the expectation that this variable is more likely to have a logarithmic than linear relationship to mood outcomes—i.e., there will be a benefit of socializing and contact with people, but there will be diminishing returns to the benefit of this variable as the amount increases. This also reduces issues with skew and outliers. Log transformation reduced skew from 4.00 to -0.05 and kurtosis from 30.41 to -0.94 . Analyses were conducted in R. Mixed models were conducted with the lme4 (50), lmerTest (51), and afex packages. Jamovi (jamovi.org) and the GAMLj module in jamovi were used to make figures. The data and code used for this analysis is publicly available on Open Science Framework (OSF): <https://osf.io/ur27h/>.

RESULTS

Supplementary Table 1 shows correlations among all examined variables.

Model 1: Effects of SGM and Time

Coefficients and inferential statistics for the SGM $\times$ Time model are shown for all DVs in **Table 2**. These outcomes are also visualized in **Figure 2**. To briefly summarize, there was a main effect of Time on negative affect, depression, stress, and worry such that each of these metrics decreased over the course of the three assessment windows (all p 's < 0.016). There was also a main effect of SGM on depression ($p < 0.001$), but the SGM and non-SGM cohorts did not differ on reports of affect, stress, or worry. There were no significant interactions between SGM status and time across all three assessment windows. For subjective experience of stress, however, there was a trend toward an overall SGM $\times$ Time interaction ($p = 0.089$) which became significant when focusing on comparisons between the early and middle time bin ($p = 0.028$). While non-SGM participants showed a reduction in stress between the early and middle time bin, SGM participants showed no such stress reduction; SGM participants did, however, show a reduction in stress between the middle and

late time bins, such that by the late time bin, there were no group differences in stress ($p = 0.111$).

When examining the measures of social interaction and isolation as dependent variables to first understand how these variables changed across groups and time, a main effect of Time was observed for both variables (p 's < 0.001), with both variables generally decreasing over time. There were no effects of SGM status or SGM $\times$ Time interaction (**Figure 3**).

Model 2: Effects of SGM, Time, and Social Isolation

Coefficients and inferential statistics for the SGM $\times$ Time $\times$ Social Isolation model are shown in **Table 3** and visualized in **Supplementary Figure 1**. Across all participants, there was a main effect of social isolation such that greater perception of being socially isolated was associated with decreased PANAS positive scale scores and increased PANAS negative, depression, stress, and worry (all $p < 0.001$). There were no significant SGM $\times$ Isolation or three-way SGM $\times$ Time $\times$ Social Isolation interactions for any of the dependent variables of interest. There was a significant Time $\times$ Isolation interaction on negative affect and depression, such that the effect of social isolation on these variables was greater in the earlier time bins compared to the late time bin (May 7 - May 20).

Model 3: Effects of SGM, Time, and Virtual Socialization

Coefficients and inferential statistics for the SGM $\times$ Time $\times$ Virtual Socialization model are shown in **Table 4**. There was no main effect of virtual socialization on any metric nor any interactions with virtual socialization. This model did, however, reveal a main effect of Time on PANAS negative, stress, depression (all $p < 0.001$) and worry ($p < 0.05$), with the former two measures showing reductions in these negative mental health consequences between the early and the middle time bin, and with all of those measures showing reductions when comparing the early to the late time bin.

Model 4: Effects of SGM, Virtual Socialization, and Reported Quarantine

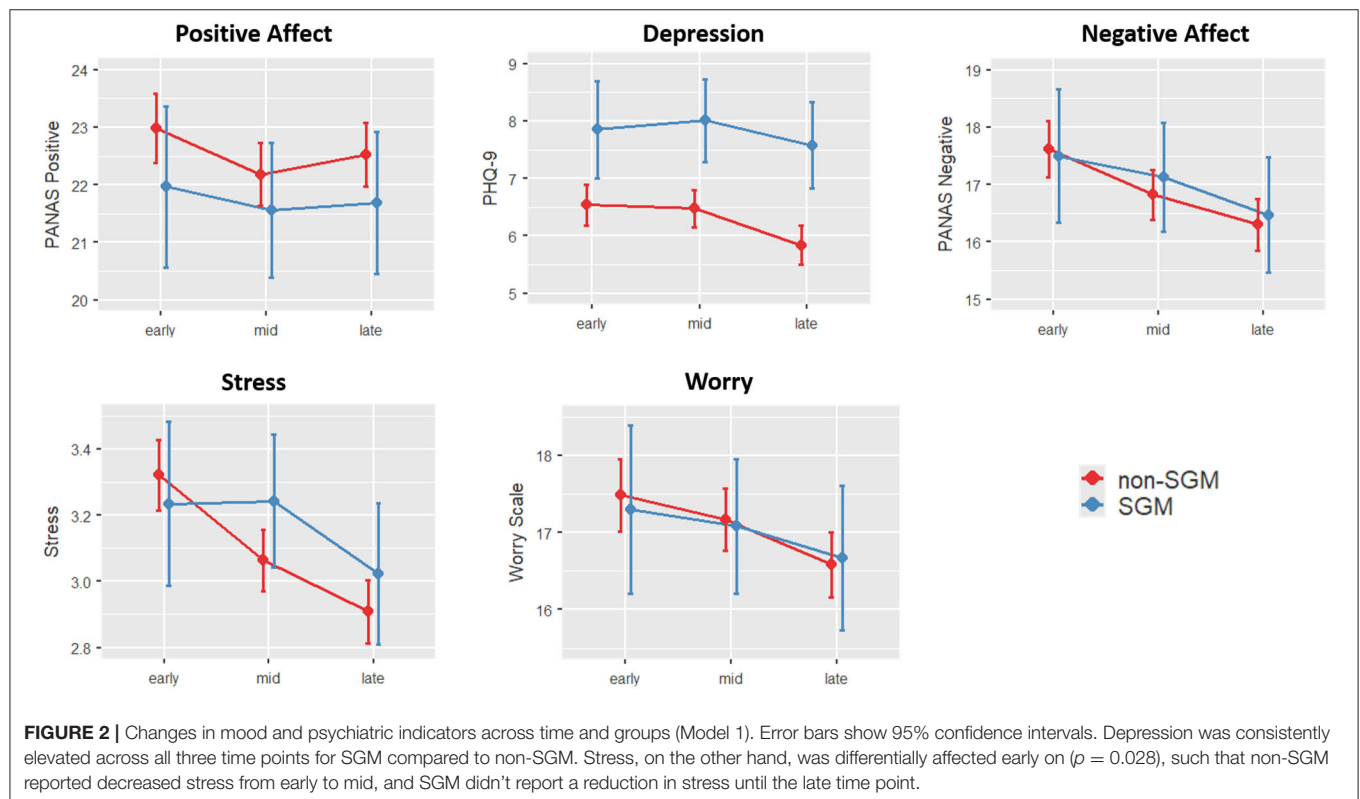
Coefficients and inferential statistics for the SGM $\times$ Virtual Socialization $\times$ Quarantine model are shown in **Table 5**. This model showed a main effect of SGM status on depression (greater depression in those with SGM status). Depression also showed a Quarantine $\times$ Virtual Socialization interaction, with Virtual Socialization having a greater reduction on depression in those who reported being quarantined (**Figure 4**). In this model, a significant effect of Virtual Socialization was revealed on PANAS positive, with increased socialization associated with greater positive affect. This effect may have been significant here but not in Model 3 either because time is removed as a factor in this model or because quarantine is added.

While there were no main effects of SGM status for any worry variables, exploratory analyses revealed an SGM $\times$ Virtual Socialization interaction for financial worry, whereby those with

TABLE 2 | Model 1 regression results.

	PANAS positive	PANAS negative	mPHQ-9	Stress	Worry Composite
Intercept	22.15 [21.55, 22.75]	16.97 [16.50, 17.45]	7.05 [6.68, 7.42]	3.13 [3.03, 3.23]	17.05 [16.61, 17.48]
Age	F(1.00, 961.82) = 177.81, $p < 0.001$	F(1.00, 936.84) = 18.01, $p < 0.001$	F(1.00, 949.09) = 31.48, $p < 0.001$	F(1.00, 974.30) = 36.24, $p < 0.001$	F(1.00, 957.09) = 8.59, $p = 0.003$
Age	0.19 [0.16, 0.22], $p < 0.001$	-0.05 [-0.07, -0.03], $p < 0.001$	-0.05 [-0.07, -0.03], $p < 0.001$	-0.01 [-0.02, -0.01], $p < 0.001$	-0.03 [-0.05, -0.01], $p = 0.003$
SGM_status	F(1.00, 1,018.84) = 1.81, $p = 0.179$	F(1.00, 1,004.33) = 0.06, $p = 0.811$	F(1.00, 999.69) = 16.42, $p < 0.001$	F(1.00, 1,058.73) = 0.44, $p = 0.508$	F(1.00, 1,035.16) = 0.02, $p = 0.889$
SGM - non-SGM	-0.83 [-2.03, 0.38], $p = 0.179$	0.12 [-0.84, 1.08], $p = 0.811$	1.53 [0.79, 2.28], $p < 0.001$	0.07 [-0.14, 0.27], $p = 0.508$	-0.06 [-0.94, 0.81], $p = 0.889$
Time	F(2.00, 948.97) = 1.78, $p = 0.169$	F(2.00, 954.57) = 8.44, $p < 0.001$	F(2.00, 916.90) = 6.96, $p = 0.001$	F(2.00, 1,060.91) = 14.04, $p < 0.001$	F(2.00, 1,008.26) = 4.15, $p = 0.016$
Mid - early	-0.60 [-1.24, 0.03], $p = 0.063$	-0.58 [-1.14, -0.03], $p = 0.039$	0.05 [-0.32, 0.42], $p = 0.798$	-0.12 [-0.24, -0.01], $p = 0.039$	-0.27 [-0.81, 0.28], $p = 0.340$
Late - early	-0.36 [-1.03, 0.30], $p = 0.286$	-1.18 [-1.75, -0.60], $p < 0.001$	-0.49 [-0.87, -0.10], $p = 0.013$	-0.31 [-0.44, -0.19], $p < 0.001$	-0.76 [-1.33, -0.19], $p = 0.009$
SGM x Time	F(2.00, 948.95) = 0.20, $p = 0.816$	F(2.00, 954.54) = 0.29, $p = 0.745$	F(2.00, 916.88) = 0.62, $p = 0.538$	F(2.00, 1,060.81) = 2.42, $p = 0.089$	F(2.00, 1,008.24) = 0.13, $p = 0.875$
(SGM - non-SGM) x (mid - early)	0.39 [-0.88, 1.66], $p = 0.551$	0.43 [-0.67, 1.53], $p = 0.445$	0.22 [-0.52, 0.96], $p = 0.559$	0.27 [0.03, 0.50], $p = 0.028$	0.10 [-0.99, 1.19], $p = 0.858$
(SGM - non-SGM) x (late - early)	0.17 [-1.16, 1.50], $p = 0.798$	0.28 [-0.87, 1.44], $p = 0.630$	0.43 [-0.34, 1.20], $p = 0.277$	0.20 [-0.05, 0.45], $p = 0.111$	0.28 [-0.86, 1.41], $p = 0.636$

Coefficients and 95% confidence interval of the coefficient for each effect for each dependent variable. All models included a main effect of age to control for the contribution of age effects. Confidence intervals calculated from the log likelihood ratio test. P-values were calculated from the t-distribution with a Satterthwaite approximation for the degrees of freedom. Coefficients that were significantly different from 0 at $\alpha = 0.05$ are in bold. mPHQ-9, modified PHQ-9 with all questions except suicidality.



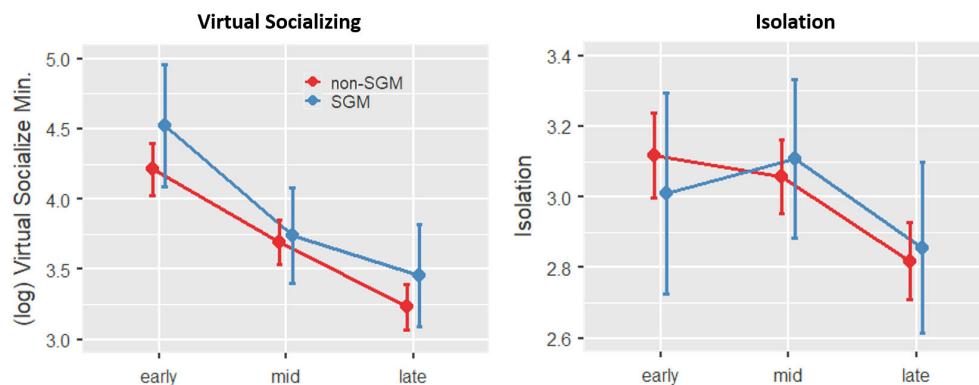


FIGURE 3 | Changes in social engagement and reported feelings of isolation across time and groups (Models 2 and 3). Error bars show 95% confidence intervals. SGM and non-SGM reported similar patterns of progressively decreasing engagement in virtual socializing across the three time points, corresponding to reduced feelings of isolation specifically at the final time point.

SGM status who socialized more reported more financial worry (see **Supplementary Table 2**).

Multiple Comparisons Correction

The multiple models, predictors, and DVs employed in our analysis raise potential multiple comparisons concerns. The main pattern in our results was that there were few significant differences between SGM and cisgender heterosexual participants. That these differences remained non-significant across most DVs and modeling choices with no correction actually gives more confidence in the robustness of this finding (with a strict multiple comparisons correction, non-significant results would be more likely to be due to low power). In addition, the differences that were found, such as greater depression for SGM participants and effects of Time, were generally consistent across models.

Nevertheless, to bolster the interpretation of significant results, we applied the Benjamini and Hochberg (52) false discovery rate (FDR) correction across all *F*-tests in our four main models and five main dependent variables (PANAS positive, PANAS negative, PHQ-9, stress, and the worry scale). Exploratory analyses (e.g., of each separate worry question) were not included in this correction, nor was the effect of age, since this was included simply as a control variable that had already been tested in previous work (Cunningham et al., in revision). This resulted in 126 *p*-values being submitted to the correction algorithm.

The FDR-corrected alpha was ~ 0.009 ; in other words, any uncorrected $p < 0.009$ remained significant after FDR correction. As a result, 3 of the 25 effects that were significant in the uncorrected results became non-significant with FDR correction: the Time * Isolation interaction for PHQ-9 in Model 2, the Time effect for the worry scale in Model 1, and the Time effect for the worry scale in Model 3. Notably, all significant effects that included SGM status remained significant after correction.

DISCUSSION

The goal of the current study was to investigate changes in mental health outcomes during the initial stages of the US

response to the COVID-19 pandemic to determine the extent to which they differed as a function of SGM status. In addition, we sought to explore how perceptions of social isolation and virtual socialization were related to changes in mental health outcomes. Our results suggest few differences in how mental health outcomes changed over time for SGM and cisgender heterosexual persons. Consistent with our initial hypothesis, we found that SGM participants reported greater depression symptoms than cisgender heterosexual individuals across the entirety of the study. However, the rate of change of depression and other mental health outcomes did not differ by SGM status, which was inconsistent with our initial hypotheses. Additionally, though decreased social connectedness and increased time spent engaging in virtual socializing were associated with better mental health, there were no differences by SGM status, again contrary to our hypotheses. These results begin to shed light on potential ways in which the current global pandemic affect mental health among different populations, and must be appreciated with specific reference to the nature of these data. Given that empirical investigations of the mental health impact of COVID-19 are in their infancy, we focus on qualifying our findings, with important directions for future research aimed at holistically understanding mental health vulnerabilities related to the current global pandemic. We believe that these qualifications are particularly noteworthy since these data reflect a non-representative convenience sample of U.S. adults.

When compared with cisgender heterosexual participants, the SGM sample in this study reported significantly younger age. Previous research highlights the particular vulnerabilities faced by older SGM persons to loneliness and social isolation as they age (53–56). Even greater limitations to social connections and increased isolation as a result of the COVID-19 pandemic might impact older SGM adults more so than those represented within our sample. Older SGM individuals are more likely to live alone and lack potential family support systems when compared with their cisgender heterosexual peers (57). Additionally, specific barriers to accessing social support may be potentiated among older SGM individuals (57). Therefore, while these results suggest that the detrimental impact of the pandemic response, and the

TABLE 3 | Model 2 regression results.

	PANAS positive	PANAS negative	mPHQ9	Stress	Worry Composite
Intercept	22.28 [21.70, 22.86]	16.87 [16.42, 17.31]	6.93 [6.59, 7.26]	3.08 [3.00, 3.16]	16.95 [16.55, 17.35]
Age	F(1.00, 960.08) = 180.14, p < 0.001	F(1.00, 907.78) = 15.50, p < 0.001	F(1.00, 911.05) = 31.49, p < 0.001	F(1.00, 883.60) = 44.96, p < 0.001	F(1.00, 944.31) = 6.37, p = 0.012
Age	0.19 [0.16, 0.21], p < 0.001	-0.04 [-0.06, -0.02], p < 0.001	-0.04 [-0.06, -0.03], p < 0.001	-0.01 [-0.02, -0.01], p < 0.001	-0.02 [-0.04, -0.01], p = 0.012
SGM	F(1.00, 1,021.44) = 1.86, p = 0.172	F(1.00, 985.49) = 0.14, p = 0.704	F(1.00, 973.71) = 19.42, p < 0.001	F(1.00, 976.66) = 0.24, p = 0.628	F(1.00, 1,027.23) = 0.01, p = 0.921
SGM - non-SGM	-0.81 [-1.97, 0.35], p = 0.172	0.17 [-0.72, 1.06], p = 0.704	1.51 [0.84, 2.18], p < 0.001	0.04 [-0.12, 0.20], p = 0.628	-0.04 [-0.85, 0.76], p = 0.921
Time	F(2.00, 955.47) = 2.20, p = 0.112	F(2.00, 955.74) = 6.00, p = 0.003	F(2.00, 909.01) = 2.52, p = 0.081	F(2.00, 984.15) = 5.90, p = 0.003	F(2.00, 1,011.52) = 1.19, p = 0.306
Mid - early	-0.61 [-1.24, 0.01], p = 0.054	-0.62 [-1.17, -0.08], p = 0.025	0.08 [-0.28, 0.44], p = 0.658	-0.11 [-0.22, 0.00], p = 0.058	-0.26 [-0.78, 0.25], p = 0.312
Late - early	-0.65 [-1.30, 0.01], p = 0.054	-1.01 [-1.58, -0.44], p = 0.001	-0.25 [-0.63, 0.13], p = 0.203	-0.20 [-0.32, -0.09], p = 0.001	-0.42 [-0.96, 0.11], p = 0.124
Isolation	F(1.00, 1,783.82) = 60.61, p < 0.001	F(1.00, 1,794.19) = 72.41, p < 0.001	F(1.00, 1,784.75) = 124.45, p < 0.001	F(1.00, 1,756.30) = 296.19, p < 0.001	F(1.00, 1,785.11) = 112.60, p < 0.001
Isolation	-1.23 [-1.53, -0.92], p < 0.001	1.10 [0.85, 1.35], p < 0.001	1.02 [0.84, 1.20], p < 0.001	0.43 [0.38, 0.48], p < 0.001	1.26 [1.03, 1.50], p < 0.001
SGM × Time	F(2.00, 955.45) = 0.44, p = 0.643	F(2.00, 955.72) = 0.15, p = 0.863	F(2.00, 908.99) = 0.52, p = 0.596	F(2.00, 984.15) = 1.26, p = 0.284	F(2.00, 1,011.51) = 0.02, p = 0.977
(SGM - non-SGM) × (mid - early)	0.57 [-0.67, 1.81], p = 0.372	0.19 [-0.90, 1.28], p = 0.735	0.08 [-0.65, 0.80], p = 0.836	0.18 [-0.04, 0.40], p = 0.113	-0.08 [-1.11, 0.94], p = 0.875
(SGM - non-SGM) × (late - early)	0.28 [-1.03, 1.58], p = 0.681	-0.04 [-1.19, 1.10], p = 0.942	0.34 [-0.43, 1.10], p = 0.390	0.13 [-0.11, 0.36], p = 0.284	-0.00 [-1.08, 1.08], p = 0.998
SGM × Isolation	F(1.00, 1,783.92) = 0.19, p = 0.666	F(1.00, 1,794.13) = 1.33, p = 0.248	F(1.00, 1,784.86) = 0.90, p = 0.343	F(1.00, 1,756.14) = 1.49, p = 0.223	F(1.00, 1,785.02) = 2.20, p = 0.138
(SGM - non-SGM) × isolation	-0.14 [-0.75, 0.48], p = 0.666	-0.30 [-0.80, 0.21], p = 0.248	0.17 [-0.18, 0.53], p = 0.343	-0.06 [-0.16, 0.04], p = 0.223	-0.35 [-0.82, 0.11], p = 0.138
Time × Isolation	F(2.00, 992.54) = 1.21, p = 0.298	F(2.00, 1,002.91) = 5.23, p = 0.005	F(2.00, 946.81) = 4.71, p = 0.009	F(2.00, 1,040.86) = 2.59, p = 0.076	F(2.00, 1,061.65) = 1.25, p = 0.286
(Mid - early) × isolation	-0.24 [-0.73, 0.25], p = 0.337	-0.06 [-0.49, 0.36], p = 0.773	0.12 [-0.16, 0.41], p = 0.395	0.09 [0.01, 0.18], p = 0.035	0.26 [-0.14, 0.66], p = 0.204
(Late - early) × isolation	0.03 [-0.48, 0.53], p = 0.922	-0.53 [-0.97, -0.09], p = 0.018	-0.20 [-0.49, 0.09], p = 0.186	0.10 [0.01, 0.19], p = 0.033	0.33 [-0.08, 0.74], p = 0.115
SGM × Time × Isolation	F(2.00, 992.69) = 0.02, p = 0.981	F(2.00, 1,003.09) = 1.12, p = 0.328	F(2.00, 946.96) = 0.82, p = 0.441	F(2.00, 1,041.03) = 1.01, p = 0.364	F(2.00, 1,061.83) = 0.10, p = 0.909
(SGM - non-SGM) × (mid - early) × isolation	0.05 [-0.94, 1.03], p = 0.928	-0.31 [-1.17, 0.55], p = 0.478	-0.31 [-0.88, 0.26], p = 0.290	0.00 [-0.17, 0.17], p = 0.993	-0.08 [-0.89, 0.72], p = 0.840
(SGM - non-SGM) × (late - early) × isolation	-0.03 [-1.03, 0.98], p = 0.961	-0.63 [-1.51, 0.24], p = 0.160	-0.38 [-0.96, 0.20], p = 0.204	-0.09 [-0.26, 0.09], p = 0.342	-0.17 [-1.00, 0.65], p = 0.682

Coefficients and 95% confidence interval of the coefficient for each effect for each dependent variable. All models included a main effect of age to control for the contribution of age effects. Confidence intervals calculated from the log likelihood ratio test. P-values were calculated from the t-distribution with a Satterthwaite approximation for the degrees of freedom. Coefficients that were significantly different from 0 at $\alpha = 0.05$ are in bold. mPHQ-9, modified PHQ-9 with all questions except suicidality.

buffering role that social connectedness and (virtual) activity play, differs little across SGM status, we must qualify this finding by highlighting that these results pertain to *younger-to-middle-aged SGM adults*.

The majority of our SGM sample reported bisexual orientation (~70%), female sex (85%), and cisgender identity (94%). However, despite a robust literature documenting worse health outcomes among bisexual individuals when compared with heterosexual and lesbian/gay individuals (58–62), we found

few differences based on SGM status. Nonetheless, bisexual identity is not the driver of mental health disparities *per se*. Instead, previous studies indicate that individuals who report bisexual identity experience greater levels of bi-negativity from both the heterosexual and lesbian/gay communities [e.g., (58–62)]. Minority stress drives mental health disparities. Without measuring experiences/perceptions of bi-negative discrimination or stigma, we are unable to quantify the extent to which such a variable might be related to our findings. For

TABLE 4 | Model 3 regression results.

	PANAS positive	PANAS negative	mPHQ9	Stress	Worry Composite
Intercept	22.14 [21.54, 22.74]	16.98 [16.50, 17.47]	7.04 [6.67, 7.42]	3.14 [3.04, 3.24]	17.07 [16.63, 17.51]
Age	F(1.00, 962.22) = 172.38, p < 0.001	F(1.00, 940.21) = 18.20, < 0.001	F(1.00, 953.70) = 31.64, p < 0.001	F(1.00, 979.38) = 36.27, p < 0.001	F(1.00, 960.53) = 8.72, p = 0.003
Age	0.19 [0.16, 0.22], p < 0.001	−0.05 [−0.07, −0.03], p < 0.001	−0.05 [−0.07, −0.03], p < 0.001	−0.01 [−0.02, −0.01], p < 0.001	−0.03 [−0.05, −0.01], p = 0.003
SGM	F(1.00, 1,030.61) = 1.71, p = 0.192	F(1.00, 1,019.56) = 0.01, p = 0.916	F(1.00, 1,013.16) = 15.87, p < 0.001	F(1.00, 1,085.23) = 0.33, p = 0.567	F(1.00, 1,052.54) = 0.01, p = 0.909
SGM - non-SGM	−0.80 [−2.01, 0.40], p = 0.192	0.05 [−0.91, 1.02], p = 0.916	1.52 [0.77, 2.26], p < 0.001	0.06 [−0.15, 0.27], p = 0.567	−0.05 [−0.93, 0.83], p = 0.909
Time	F(2.00, 999.93) = 1.48, p = 0.227	F(2.00, 1,007.10) = 7.33, p = 0.001	F(2.00, 966.44) = 6.61, p = 0.001	F(2.00, 1,094.28) = 12.95, p < 0.001	F(2.00, 1,062.50) = 3.85, p = 0.022
Mid - early	−0.54 [−1.22, 0.14], p = 0.122	−0.60 [−1.18, −0.01], p = 0.048	0.07 [−0.33, 0.46], p = 0.744	−0.14 [−0.26, −0.01], p = 0.031	−0.32 [−0.90, 0.26], p = 0.276
Late - early	−0.23 [−0.96, 0.50], p = 0.537	−1.18 [−1.81, −0.55], p < 0.001	−0.48 [−0.90, −0.05], p = 0.027	−0.32 [−0.45, −0.19], p < 0.001	−0.80 [−1.42, −0.19], p = 0.011
Socialize	F(1.00, 1,725.80) = 3.15, p = 0.076	F(1.00, 1,766.52) = 0.02, p = 0.889	F(1.00, 1,667.70) = 0.14, p = 0.706	F(1.00, 1,873.41) = 0.01, p = 0.913	F(1.00, 1,793.29) = 0.06, p = 0.808
Socialize	0.18 [−0.02, 0.38], p = 0.076	0.01 [−0.16, 0.18], p = 0.889	0.02 [−0.10, 0.14], p = 0.706	−0.00 [−0.04, 0.03], p = 0.913	0.02 [−0.14, 0.18], p = 0.808
SGM × Time	F(2.00, 1,000.10) = 0.15, p = 0.863	F(2.00, 1,007.28) = 0.53, p = 0.590	F(2.00, 966.62) = 0.46, p = 0.630	F(2.00, 1,094.28) = 2.51, p = 0.082	F(2.00, 1,062.67) = 0.07, p = 0.931
(SGM - non-SGM) × (mid - early)	0.16 [−1.20, 1.53], p = 0.817	0.60 [−0.57, 1.78], p = 0.317	0.26 [−0.53, 1.05], p = 0.517	0.29 [0.04, 0.54], p = 0.025	0.05 [−1.11, 1.21], p = 0.933
(SGM - non-SGM) × (late - early)	−0.12 [−1.58, 1.34], p = 0.870	0.37 [−0.88, 1.62], p = 0.566	0.41 [−0.43, 1.26], p = 0.338	0.22 [−0.05, 0.48], p = 0.111	0.20 [−1.03, 1.43], p = 0.753
SGM × socialize	F(1.00, 1,727.51) = 0.95, p = 0.330	F(1.00, 1,767.74) = 0.23, p = 0.629	F(1.00, 1,669.83) = 0.04, p = 0.839	F(1.00, 1,874.41) = 0.06, p = 0.814	F(1.00, 1,793.76) = 0.03, p = 0.852
(SGM - non-SGM) × socialize	−0.20 [−0.60, 0.20], p = 0.330	0.08 [−0.25, 0.42], p = 0.629	0.02 [−0.21, 0.26], p = 0.839	0.01 [−0.06, 0.08], p = 0.814	0.03 [−0.29, 0.35], p = 0.852
Time × socialize	F(2.00, 1,030.16) = 0.23, p = 0.795	F(2.00, 1,046.84) = 0.22, p = 0.806	F(2.00, 989.21) = 0.50, p = 0.608	F(2.00, 1,153.60) = 0.52, p = 0.594	F(2.00, 1,113.69) = 0.73, p = 0.484
(Mid - early) × socialize	0.11 [−0.23, 0.45], p = 0.532	0.10 [−0.20, 0.39], p = 0.517	0.06 [−0.13, 0.26], p = 0.529	0.02 [−0.04, 0.08], p = 0.465	0.17 [−0.12, 0.46], p = 0.257
(Late - early) × socialize	0.05 [−0.30, 0.40], p = 0.781	0.08 [−0.22, 0.39], p = 0.587	−0.01 [−0.21, 0.20], p = 0.948	0.03 [−0.03, 0.10], p = 0.308	0.17 [−0.13, 0.47], p = 0.269
SGM × Time × socialize	F(2.00, 1,030.11) = 0.49, p = 0.613	F(2.00, 1,046.78) = 2.04, p = 0.131	F(2.00, 989.17) = 1.54, p = 0.216	F(2.00, 1,153.59) = 0.23, p = 0.793	F(2.00, 1,113.62) = 0.61, p = 0.542
(SGM - non-SGM) × (mid - early) × socialize	0.31 [−0.38, 0.99], p = 0.384	0.02 [−0.57, 0.61], p = 0.943	0.15 [−0.25, 0.54], p = 0.468	−0.03 [−0.15, 0.10], p = 0.668	0.28 [−0.30, 0.86], p = 0.348
(SGM - non-SGM) × (late - early) × socialize	0.35 [−0.36, 1.05], p = 0.339	−0.41 [−1.02, 0.19], p = 0.184	−0.12 [−0.52, 0.29], p = 0.579	−0.04 [−0.17, 0.08], p = 0.500	0.08 [−0.51, 0.68], p = 0.782

Coefficients and 95% confidence interval of the coefficient for each effect for each dependent variable. All models included a main effect of age to control for the contribution of age effects. Confidence intervals calculated from the log likelihood ratio test. P-values were calculated from the t-distribution with a Satterthwaite approximation for the degrees of freedom. Coefficients that were significantly different from 0 at $\alpha = 0.05$ are in bold. mPHQ-9, modified PHQ-9 with all questions except suicidality.

instance, previous research suggests that for bisexual women, the gender of their romantic partner differentially relates to mental health outcomes (58). Approximately half of our SGM participants (55%) reported being involved in romantic relationships. Because we did not collect information on gender identity or sexual orientation of romantic partners, we were unable to explore the potential impact of these variables on our findings. Therefore, it is important to remember the majority bisexual, cisgender representation of our SGM sample when

interpreting these results as they likely do not reflect the impact of the social support related to the COVID-19 pandemic across all SGM subgroups.

The majority of our sample reported cisgender identity, and so it is important to note that these findings may be better considered to represent differences between groups as a function of sexual orientation. We utilized an overarching SGM group to maintain fidelity with our preregistered analysis plan. Empirical evidence documents worse psychiatric outcomes

TABLE 5 | Model 4 regression results.

	PANAS positive	PANAS negative	mPHQ9	Stress	Worry Composite
Intercept	21.84 [21.19, 22.49]	17.22 [16.69, 17.76]	7.35 [6.95, 7.75]	3.21 [3.10, 3.33]	17.15 [16.67, 17.63]
Age	F(1.00, 991.10) = 156.68, p < 0.001	F(1.00, 979.81) = 19.47, p < 0.001	F(1.00, 990.91) = 31.76, p < 0.001	F(1.00, 999.51) = 35.93, p < 0.001	F(1.00, 985.78) = 8.96, p = 0.003
Age	0.18 [0.15, 0.21], p < 0.001	−0.05 [−0.08, −0.03], p < 0.001	−0.05 [−0.07, −0.03], p < 0.001	−0.01 [−0.02, −0.01], p < 0.001	−0.03 [−0.05, −0.01], p = 0.003
SGM	F(1.00, 1,087.47) = 1.47, p = 0.225	F(1.00, 1,086.68) = 0.12, p = 0.724	F(1.00, 1,088.24) = 15.05, p < 0.001	F(1.00, 1,132.07) = 2.85, p = 0.092	F(1.00, 1,087.11) = 0.11, p = 0.739
SGM - non-SGM	−0.82 [−2.13, 0.50], p = 0.225	0.19 [−0.88, 1.29], p = 0.724	1.60 [0.80, 2.41], p < 0.001	0.19 [−0.03, 0.42], p = 0.092	−0.16 [−1.12, 0.79], p = 0.739
Quarantine	F(1.00, 386.94) = 0.00, p = 0.970	F(1.00, 382.66) = 0.94, p = 0.333	F(1.00, 272.43) = 1.48, p = 0.224	F(1.00, 385.23) = 2.78, p = 0.096	F(1.00, 385.84) = 0.10, p = 0.758
Quarantined - notquarantined	−0.02 [−1.05, 1.01], p = 0.970	0.43 [−0.44, 1.29], p = 0.333	0.35 [−0.21, 0.92], p = 0.224	0.15 [−0.03, 0.33], p = 0.096	0.12 [−0.64, 0.88], p = 0.758
Socialize	F(1.00, 834.75) = 11.30, p = 0.001	F(1.00, 842.77) = 0.62, p = 0.432	F(1.00, 655.73) = 1.34, p = 0.247	F(1.00, 793.35) = 0.03, p = 0.872	F(1.00, 839.77) = 1.66, p = 0.197
(log2) Socialize	0.49 [0.20, 0.77], p = 0.001	0.09 [−0.14, 0.33], p = 0.432	−0.10 [−0.26, 0.07], p = 0.247	−0.00 [−0.05, 0.04], p = 0.872	0.14 [−0.07, 0.35], p = 0.197
SGM x Quarantine	F(1.00, 388.21) = 0.15, p = 0.703	F(1.00, 383.98) = 0.06, p = 0.805	F(1.00, 273.19) = 0.14, p = 0.707	F(1.00, 386.42) = 1.29, p = 0.256	F(1.00, 387.14) = 0.31, p = 0.577
(SGM - non-SGM) x (quarantined - notquarantined)	0.40 [−1.65, 2.46], p = 0.703	0.22 [−1.54, 1.98], p = 0.805	−0.22 [−1.35, 0.92], p = 0.707	0.21 [−0.15, 0.56], p = 0.256	−0.43 [−1.94, 1.08], p = 0.577
SGM x Socialize	F(1.00, 833.48) = 0.08, p = 0.776	F(1.00, 841.31) = 0.91, p = 0.339	F(1.00, 655.30) = 0.11, p = 0.738	F(1.00, 791.94) = 0.24, p = 0.625	F(1.00, 838.40) = 1.29, p = 0.256
(SGM - non-SGM) x (log2) Socialize	0.08 [−0.49, 0.65], p = 0.776	0.23 [−0.24, 0.70], p = 0.339	0.06 [−0.28, 0.39], p = 0.738	0.02 [−0.07, 0.12], p = 0.625	0.24 [−0.17, 0.66], p = 0.256
Quarantine x Socialize	F(1.00, 421.89) = 2.18, p = 0.140	F(1.00, 420.39) = 2.26, p = 0.133	F(1.00, 290.93) = 12.26, p = 0.001	F(1.00, 423.02) = 0.36, p = 0.549	F(1.00, 422.27) = 0.17, p = 0.678
(Quarantined - notquarantined) x (log2) Socialize	0.38 [−0.12, 0.88], p = 0.140	−0.32 [−0.74, 0.10], p = 0.133	−0.50 [−0.77, −0.22], p = 0.001	−0.03 [−0.11, 0.06], p = 0.549	0.08 [−0.29, 0.45], p = 0.678
SGM x Quarantine x Socialize	F(1.00, 421.87) = 2.27, p = 0.133	F(1.00, 420.36) = 0.66, p = 0.417	F(1.00, 290.93) = 3.07, p = 0.081	F(1.00, 422.89) = 0.25, p = 0.616	F(1.00, 422.24) = 0.09, p = 0.769
(SGM - non-SGM) x (quarantined - notquarantined) x (log2) Socialize	0.78 [−0.23, 1.78], p = 0.133	−0.35 [−1.19, 0.49], p = 0.417	−0.50 [−1.05, 0.06], p = 0.081	0.04 [−0.12, 0.21], p = 0.616	−0.11 [−0.85, 0.63], p = 0.769

Coefficients and 95% confidence interval of the coefficient for each effect for each dependent variable. All models included a main effect of age to control for the contribution of age effects. Confidence intervals calculated from the log likelihood ratio test. P-values were calculated from the t-distribution with a Satterthwaite approximation for the degrees of freedom. Coefficients that were significantly different from 0 at $\alpha = 0.05$ are in bold. mPHQ-9, modified PHQ-9 with all questions except suicidality.

for transgender and gender nonconforming individuals when compared with their cisgender counterparts (63–65). It is imperative that future research with greater representation of non-cisgender participants be conducted. Finally, our sample was well educated (>80% with at least a college degree), employed (79%), and mostly non-Hispanic (93%) and white (81%). The epidemiology of psychopathology is stratified according to sexual orientation and race/ethnicity, wherein Hispanic and Black LGB persons experience unlike prevalence of psychiatric disorders when compared with their non-Hispanic white counterparts (19). Socioeconomic status is also inversely associated with mental health outcomes [e.g., (66)]. When considered together, these sample characteristics help us qualify to whom our findings apply. Bearing these qualifications in mind, our results demonstrate that (1) SGM individuals,

even those who might belong to social groups with relatively greater psychosocial privilege, nonetheless report worse mental health symptoms when compared with cisgender heterosexual individuals; (2) across the initial phase of the U.S. pandemic response, participants—regardless of sexual orientation and gender identity—experienced decrements in their reported mental health; and (3) social connectedness and maintaining social activities, even in virtual formats, can help buffer against the negative mental health in the face repercussions of the global COVID-9 pandemic.

LIMITATIONS

There are some notable limitations to our study here. First, the data collected here is likely just a snapshot of the impact of the

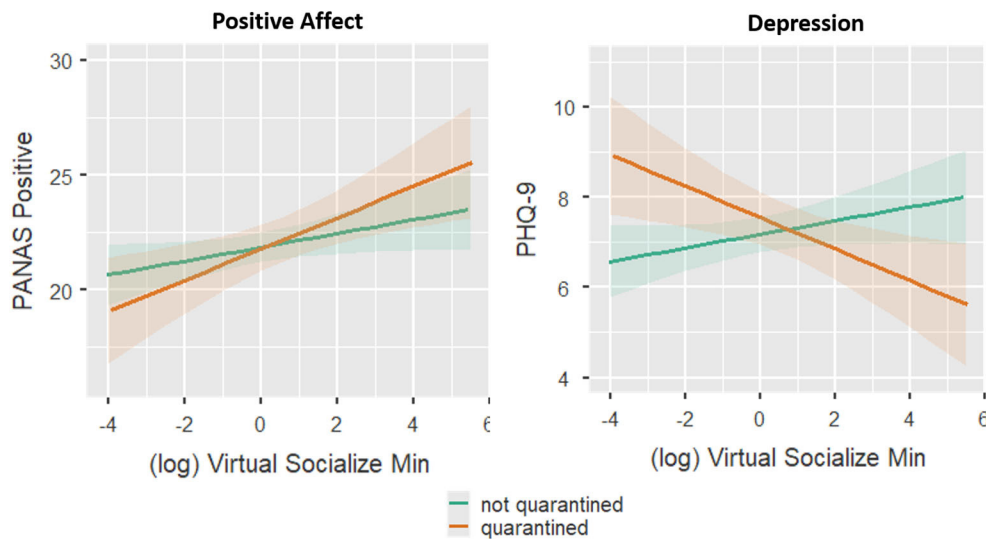


FIGURE 4 | Effects of minutes spent socializing virtually and quarantine on positive affect and depression symptomology (Model 4). Minutes spent socializing virtually is $\log_2$ transformed (see text) and then mean centered (i.e., 0 represents the mean of the log transformed minutes across all observations). Shading around the lines show the 95% confidence interval.

“first wave” of the COVID-19 pandemic in the United States. Even with the start of our data collection beginning in mid-March as cases in the US were initially on the rise and stay-at-home orders were being first introduced, as our measures largely showed improvement over time, it is likely that the uncertainty surrounding the spread of the disease and the severity of its health impact were already taking a substantial toll on mental health and well-being at the start of assessment [for further details see (Cunningham et al., in revision)]. As the pandemic continues to persist and have social and economic impacts, it is possible that the sustained impacts of COVID-19 may begin to again deteriorate mental well-being, and that the chronicity of these stressors may differentially impact different groups. Further, the lack of pre-COVID data limits our capacity to determine if the reported effects would have been the same regardless of the pandemic. We recognize that the current report approaches our question from a biomedical framework, focusing on psychological constructs abstracted from an individual’s lived experience and societal factors that may have contributed to them. Our metrics likely do not capture the full extent of potential mental health disparities SGM individuals may be experiencing during this pandemic, nor do we intend to marginalize such experiences. Our use of a binary “yes/no” response to inquire about whether participants were under quarantine at the time of the assessment. Participants reported a number of different interpretations of this question (e.g., medically ordered quarantine vs. extreme social distancing). As such, this question best describes participants’ *perception* of whether or not they were “under quarantine.” Further work should explore the differential impact of these different types of isolation and more specifically separate individuals that remained socially active and participants that were socially isolated, whether it was self-imposed or not.

Both sexual and gender minority populations evidence higher prevalence of various forms of psychosocial dysfunction when compared with cisgender heterosexual populations. Given the emerging nature of this literature specifically related to the potential impact of the COVID-19 pandemic on mental health, we felt it important to include gender minority persons within our analyses to avoid erasure of this marginalized population. It is noteworthy that due to the particularly minor representation of gender minority individuals within these data ($n = 8$ transgender participants) we were (1) unable to stratify our analyses by sexual vs. gender minority status and (2) advise caution in the extent to which these conclusions pertain specifically to gender minority persons. Though both sexual and gender minority individuals face psychiatric disparities of a similar nature, grounded in minority stress processes related to their marginalized identities, we reiterate our belief that future studies that better represent the diversity within SGM populations must be pursued to more accurately profile the ways in which the global pandemic might differentially impact already marginalized populations. While we have discussed how the idiosyncratic characteristics of this sample are likely to impact the generalizability of our results, it is important to highlight that these data represent a convenience sample that was limited to individuals that we could reasonably reach using online recruitment techniques. While this work begins to shed light on the potential impact of the COVID-19 pandemic, we want to underscore the importance of replication and expansion of these findings using more representative data.

CONCLUSION

The current global COVID-19 pandemic represents an unprecedented period of distress with substantial upheaval

to individual's regular lives. Health responses designed to contain the spread of the disease might compromise mental well-being for individuals, with potentially disproportionate impact on marginalized populations who already experience increased psychiatric prevalence. The findings of the current study reveal the buffering effect of social support on preserving individuals' mental health. Although SGM individuals report greater symptoms of depression when compared with their cisgender heterosexual peers, the change of mental health outcomes over time was independent of SGM status. These findings begin to characterize the important mental health effect of the COVID-19 pandemic, and highlight the importance of increasing research aimed at understanding this effect among less homogeneous samples.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are publicly available. This data can be found here: <https://osf.io/ur27h/>.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Boston College Institutional Review Board. The patients/participants provided their written informed consent to participate in this study.

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AUTHOR CONTRIBUTIONS

TC and EK conceived and designed the study. TC conducted data gathering. TC, EF, and EK devised the analysis plan and performed statistical analyses. CR-S, EF, RB, SK, MG, EK, JP, and TC drafted and revised the manuscript. All authors contributed to the article and approved the submitted version.

FUNDING

TC, RB, MG, and EF would like to thank their NIH T32 funding sources for supporting their work and ongoing training. TC, RB, and MG are currently funded by the Research Training Program in Sleep, Circadian and Respiratory Neurobiology (NIH T32 HL007901) through the Division of Sleep Medicine at Harvard Medical School and Brigham & Women's Hospital. EF is currently funded by NIH NRSA T32 NS007292 through Brandeis University. Additional funding for the project was provided by Boston College.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2020.590318/full#supplementary-material>

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Loneliness, Emotion Dysregulation, and Internalizing Symptoms During Coronavirus Disease 2019: A Structural Equation Modeling Approach

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OPEN ACCESS

Edited by:

Paola Aceto,
Catholic University of the Sacred
Heart, Italy

Reviewed by:

Maria Picó-Pérez,
University of Minho, Portugal
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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 08 July 2020

Accepted: 30 November 2020

Published: 08 January 2021

Citation:

Velotti P, Rogier G,
Beomonte Zobel S, Castellano R and
Tambelli R (2021) Loneliness, Emotion
Dysregulation, and Internalizing
Symptoms During Coronavirus
Disease 2019: A Structural Equation
Modeling Approach.
Front. Psychiatry 11:581494.
doi: 10.3389/fpsy.2020.581494

Background: Our study aimed to test the hypotheses that an increased level of loneliness experienced during coronavirus disease 2019 (COVID-19) confinement was predictive of internalizing symptoms and that this pathway was mediated by emotion dysregulation levels.

Methods: To reach this aim, we performed an online longitudinal survey recruiting 1,330 participants at Time 1 (at the beginning of the lockdown) and 308 participants at Time 2 (few days before the end of the lockdown). All filled out a set of questionnaires: demographic data, University of California, Los Angeles Loneliness scale, Difficulties in Emotion Regulation Scale—18 items, and Depression Anxiety and Stress Scale—21 items. Hypotheses were tested using structural equation modeling in two steps and controlling for age. First, hypotheses were tested on cross-sectional data. Then, a cross-lagged panel analysis was performed on longitudinal data.

Results: Models obtained a good fit and evidenced the predictive role of loneliness levels on the three outcomes (i.e., depression, anxiety, and stress). Moreover, we found that emotion dysregulation levels partially mediated the longitudinal relationship between loneliness and both depression and stress but not between loneliness and anxiety levels.

Conclusions: This study points out that a central goal of clinical intervention could be the ability to regulate negative emotional states.

Keywords: loneliness, emotion dysregulation, depression, stress, anxiety

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic poses challenges never before faced in society from many angles. It affects not only the state of health and integrity of our body endangered by COVID-19 but also the health and integrity of our mind, and the effects on the mental health of COVID-19 are expected to be diverse (1).

During a pandemic, not only the virus, with the consequent fear of contagion and death, but also the lockdown measures imposed by the various states contribute as stress factors affecting people's

well-being (2–10). Indeed, according to a survey conducted in the United Kingdom on pandemic concerns (1), the prospect of contracting the severe acute respiratory syndrome coronavirus 2 was judged to be less worrying compared with psychological and social responses to the situation.

Furthermore, the answers of governments to fight the spreading of the virus, remaining physically distanced from relatives and friends, have determined a common condition of social isolation. As already known from the literature, social isolation is considered a risk factor for diverse psychopathological manifestations, such as anxiety (5, 6, 11), depressed mood (6, 7, 12, 13), substance abuse, domestic violence, suicide, and self-harm (14–16) and a trigger for some threatening conditions such as loneliness. A rapid review conducted by Brooks et al. (17) provided an overview of psychological effects related to quarantine, which occurred in acute, going from general psychological distress to post-traumatic stress symptoms (8, 18). Some studies have investigated long-term effects of the isolation experience with follow-ups, finding that PTSD and depressive symptoms persisted in a part of the sample even after 3 years from the epidemic outburst (13, 19).

Indeed, a wide body of research suggests that social isolation (i.e., the objective condition of isolation), psychological stress, and loneliness (i.e., subjective condition of isolation) have an unfavorable effect on many health outcomes, including mortality (20, 21). For this reason, the increase in social isolation and loneliness needs to be considered among the most important probable negative consequence of COVID-19, as evidenced by the surveys conducted by Holmes et al. (1).

LONELINESS AND EMOTION REGULATION

Loneliness, defined as the pain of feeling alone (22), is a psychological condition characterized by a deep sense of emptiness and uselessness, lack of control, and personal threat (23, 24). Studies have shown that loneliness can lead to more serious physical and mental health problems such as internet addiction, suicide ideation, and substance use (25, 26). Loneliness also seems to be linked to internalizing symptoms such as depression in both adolescents (27–31) and adults (32–35), anxiety (36, 37), and—moreover—social anxiety (32, 38, 39).

However, research (40) highlights that diverse factors are involved in loneliness, such as individual (i.e., personality features) and contextual facets (i.e., social isolation). For instance, a meta-analysis study focused on adolescence found that the most powerful predictors of loneliness were individual characteristics such as low self-esteem and social anxiety (41). Instead, from a review that investigated the phenomenon in older adults, it came out that the psychological characteristics strongly linked to loneliness were cognitive deficits, poor mental health, negative life events, and low self-efficacy beliefs (42).

From an individual perspective, emotion regulation, defined as the complex set of psychic processes that translate into one's ability to influence his/her emotions, how he/she experiences them and how he/she expresses them (43), has a decisive role

in promoting environmental adaptation and the following well-being (44). Literature has also highlighted the role of difficulties in emotion regulation as a risk factor for behavioral (45–47) and emotional problems such as substance abuse, gambling disorder, anxiety, and depression (48–51).

Nevertheless, individuals with the same level of loneliness may not experience similar psychological outcomes (52). This suggests that there might be mechanisms underlying the relationship between loneliness and internalizing symptoms, one of which seems to be emotion regulation difficulties. In fact, it has been shown that lonelier individuals make less use of adaptive emotional regulation strategies compared with individuals who suffer less from loneliness (53).

In light of these pieces of evidence, the main purpose of this study was to examine—through a structural equation model—the relationship between loneliness and internalizing symptoms, considering the mediating effect of difficulties in emotion regulation and the longitudinal link between loneliness and internalizing symptoms.

METHODS

Participants and Procedure

For the purposes of the study, an online survey was created and diffused online 3 days after the beginning of the confinement in XXX. At the beginning of the survey, an exhaustive presentation of the study's aims and scopes was delivered and information concerning anonymity and privacy. Then, the participant was asked to sign an informed consent. Three days before the end of the national lockdown, participants were sent an email asking them to fulfill the same battery of self-report questionnaires. The procedure of the study applied with the American Psychological Association official guidelines and was approved by the Ethical Committee of the University of XXX, XXXX (N. 356/20).

Measures

Demographic Information

For the purpose of the study, an initial questionnaire was created to evaluate information such as age, sex, and socioeconomic status.

University of California, Los Angeles Loneliness Scale

University of California, Los Angeles (UCLA) Loneliness Scale [(54), Italian version by (55)] was used to measure the perceived level of loneliness. The instrument is a self-report questionnaire consisting of 20 items on a four-point Likert-type scale. Empirical literature evidenced the existence of three factors underlying the structure of the instrument, namely *Intimate Others* (intimate and interpersonal loneliness), *Social Others* (lack of social networks or social friendships), and *Affiliative Environment* (a lack of belonging to the affiliative environment). In the present study, the instrument showed good internal consistency with a Cronbach alpha coefficient of 0.82.

Difficulties in Emotion Regulation Scale 18 Items

Difficulties in Emotion Regulation Scale 18 items (56) is the short version of the Difficulties in Emotion Regulation Scale (DERS)

(57, 58). As DERS, the instrument asks the participant to answer on a five-point Likert-type scale. The scale measures emotion dysregulation levels providing a total score and six separated scores related to the subscales of the instrument being *Non-Acceptance* (difficulty to accept in a non-judgmental way one's negative emotional states), *Awareness* (lack of awareness of one's negative emotions), *Clarity* (difficulty to discriminate between different negative emotional states), *Strategies* (perception of a lack of available emotion regulation strategies), *Goals* (difficulty to pursue goal-directed behavior when experiencing negative emotional states), and *Impulse* (tendency to act rashly when experiencing a negative emotion). In our study, DERS showed good internal consistency with a Cronbach alpha coefficient reaching 0.90.

Depression Anxiety and Stress Scale 21 Items

Depression Anxiety and Stress Scale 21 items (59, 60) is a self-report questionnaire consisting of 21 items on a four-point Likert-type scale. The instrument provides scores for three subscales evaluating levels of depression, anxiety, and stress. In our study, each of these subscales evidenced a good internal consistency with Cronbach's alpha coefficients being 0.91 (*Stress*), 0.88 (*Depression*), and 0.84 (*Anxiety*).

Statistical Analyses

The statistical analysis plan consisted of several steps. First, descriptive analyses were performed calculating Cronbach's alphas, frequencies, means, and standard deviations of the main variables of the study. Then, the normality of the main variables involved in the study at Time 1 was checked throughout the computation of skewness and kurtosis (61). Normality indexes all fall in the acceptable range except for the Depression Anxiety and Stress Scale Anxiety variable, which showed a normality index slightly upon the acceptable cutoff (Kurtosis = 3.04). Also, bivariate *r*-Pearson correlations were calculated to examine zero-order correlations between continuous variables involved in the study. These analyses were performed with SPSS v.24 for Windows. Then, to test the hypotheses of the study, a structural equation model was designed and tested using the *lavaan* package of the *R* software for Mac. In the models, we inserted age, sex, and education level as control variables on levels of depression, anxiety, and stress measured at Time 2. Also, we added the estimation of the covariances between the levels of depression, anxiety, and stress at Time 1 on the one hand and age, sex, and education level on the other hand. Regarding sex and education variables, they were treated as a dummy variable with 0 being females and 1 being male for sex variable and 0 being having a high school diploma or lower educational level and 1 having a higher educational level for the education variable. The method used evaluates the consistency of a dataset with a model previously defined throughout the robust maximum likelihood method of estimation. Results brought by these statistical analyses are typically judged using several goodness of fit indexes such as root mean square error of approximation (RMSEA), Tucker-Lewis coefficient (TLI), and comparative fit index (CFI). A $0.05 < \text{RMSEA} < 0.08$ (62) and both TLI and CFI being > 0.90 (63) are generally interpreted as

TABLE 1 | Means and Standard Deviations of the main variables involved in the study for the full sample (Time 1) and the subsample (Time 2).

	Time 1 (N = 1,323)		Time 2 (n = 308)	
	Mean	SD	Mean	SD
Age	35.38	14.08	35.31	13.91
UCLA Intimate	24.55	5.84	24.87	5.95
UCLA Social	0.81	1.25	1.07	1.51
UCLA Affiliative	3.35	2.03	3.86	2.35
DERS Total Score	37.97	10.85	37.58	10.85
DASS Depression	5.55	4.35	5.97	4.61
DASS Anxiety	3.01	3.46	2.84	3.41
DASS Stress	7.18	4.80	7.57	4.54

SD, Standard Deviation; UCLA, UCLA Loneliness Scale; DERS, Difficulties in Emotion Regulation Scale; DASS, Depression Anxiety and Stress Scale.

TABLE 2 | Correlations between main variables of the study.

	UCLA	DERS	Anxiety	Depression	Stress	Age
UCLA	–					
DERS	0.54	–				
Anxiety	0.39	0.45	–			
Depression	0.61	0.63	0.60	–		
Stress	0.45	0.52	0.68	0.70	–	
Age	–0.17	–0.26	–0.23	–0.20	–0.23	–

UCLA, UCLA Loneliness Scale; DERS, Difficulties in Emotion Regulation Scale. All correlation coefficient were statistically significant at $p < .001$.

an adequate fit. In addition, we examined the lower and upper boundaries of the 90% confidence interval for RMSEA, with an upper boundary of more than 0.10, indicating that the model should be rejected (62).

RESULTS

Descriptive Analyses

A total of 1,323 respondents answered the survey on Time 1. The age of participants ranged from 18 to 91 years ($M_{age} = 35.38$; $SD = 14.08$), and 23% of the sample were male. As for the characteristics of the residence, 49.2% of participants live in a big city, 33.8% in a medium-size city, and 17% in a small city or rural area. Of the participants, 52.3% achieved a high school diploma or a higher level of education. Also, almost half of the sample reported having an income of less than € 36,000 per year, and 26.5% of the participants referred to have one or more children. Because of a COVID-19 emergency, 52.6% reported having to interrupt their working activity. From this first sample, 308 of the respondents ($M_{age} = 35.31$; $SD = 13.91$; 22.7% males) participated in the second part of the study. Means and standard deviations were computed for the main variables involved in the study, both for the Total sample (Time 1) and the subsample (Time 2). These are displayed in **Table 1**.

Correlations Between Variables

r-Pearson correlations between all variables involved in the study at Time 1 were calculated. Results are fully displayed in **Table 2**.

Structural Equation Model at Time 1

To reach the aims of the study, we tested the goodness of fit of a Structural Equation Model on the whole sample participating at Time 1. Specifically, we tested, controlling for age, sex, and education levels, if UCLA scores predicted depression, anxiety, and stress levels both directly and indirectly throughout emotion dysregulation levels. To create depression, anxiety, and stress latent variables, we used the scores obtained on the items converging on the subscales of Depression Anxiety and Stress Scale-21. Loneliness Latent Variable was produced using the scores obtained on the three subscales (Intimate, Social, and Affiliative) of UCLA. Finally, the emotion dysregulation latent variable was formed using the scores obtained on the six subscales of DERS. Regarding covariates, we observed that age was significantly related to stress, education level with depression, and sex with both anxiety and stress levels.

As illustrated in **Figure 1**, the model obtained an acceptable fit as indicated by the CFI (0.91), TLI (0.90), and RMSEA indexes [0.06; confidence interval 90% (0.055–0.060)]. Moreover, all manifest variables loaded significantly on the respective latent variables. Also, we observed that UCLA scores predicted both, directly and indirectly, depression, anxiety, and stress levels.

Cross Lagged Panel Model on Longitudinal Data

To test if emotion dysregulation levels actually mediated the longitudinal link between loneliness and internalizing outcomes (depression, anxiety, and stress), we test a cross-lagged panel model throughout structural equation modeling on the subsample of longitudinal data. The tested paths and the hypothesized model are fully illustrated in **Figure 2**.

The first model test obtained an adequate fit according to the RMSEA index [0.052; CI 90% (0.049–0.056)] but was slightly below the acceptable CFI cutoff (0.88). The full model is illustrated in **Figure 2**. Consequently, we consulted the modification indexes and freed some parameters, further estimating some covariance between residual errors of some items involved in the measurement model. To obtain an adequate fit, nine parameters had to be added to the model. All of the additional covariances estimated were between manifest variables converging toward the same latent variable, maintaining coherence with our conceptual model.

The final model [RMSEA = 0.50; CI 90% (0.046–0.053); CFI = 0.90] is illustrated in **Figure 3**. Directions and statistical significances of coefficients did not differ from the first model tested. For clarity purposes, we did not display coefficients between manifest and latent variables, but all of them were positive and significant. Moreover, we found that emotion dysregulation levels partially mediated the longitudinal relationship between loneliness and both depression ($\beta = 0.006$;

$p = 0.043$) and stress ($\beta = 0.007$; $p = 0.017$) but not between loneliness and anxiety levels ($\beta = 0.002$; $p = 0.061$).

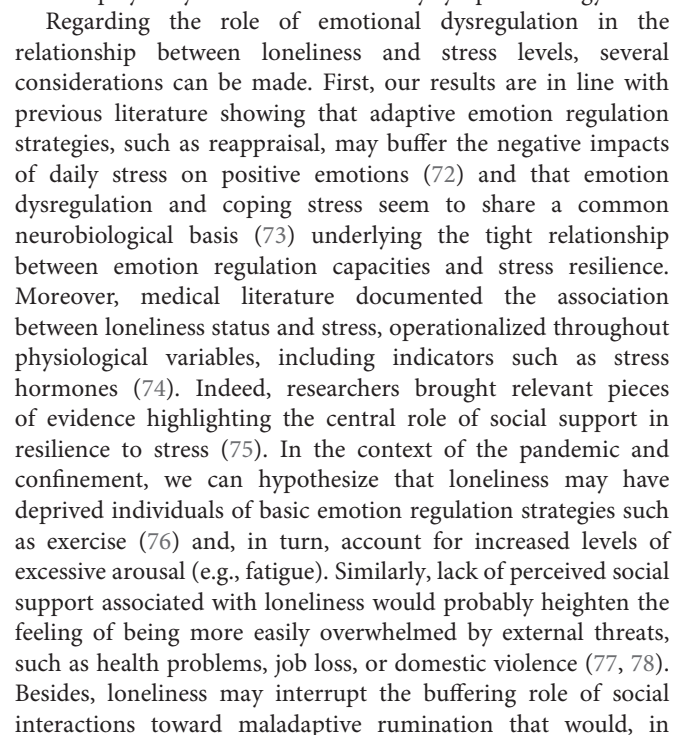
DISCUSSION

It is widely stated that in times of crisis, psychological research should address and provide answers on risk and protective factors involved in the well-being and adjustment of individuals. Empirical and anecdotal contributions have highlighted that the emergency related to COVID-19 has been very powerful in physical and psychological impacts. In the wide range of sudden changes undergone by the world population, most of them have had to face restrictive measures related to their interpersonal interactions: in many countries, the population has been asked to maintain rigorous and lasting lockdown measures to contain the pandemic. One of the consequences for most people was a reduced frequency of social interactions, which was probably translated into an increase in the level of loneliness perceived for most of them. Our focus on loneliness is linked to results that suggest that one of the most direct consequences of lockdown measures is isolation and the associated feeling of loneliness (64). Because previous research has already highlighted the negative consequences of loneliness on mental health, particularly on the maintenance, worsening or even onset of internalizing symptoms, clinical psychologists have been asked to address this central issue during the COVID-19 emergency.

However, the available empirical evidence that can provide useful clinical indications for dealing with psychological problems caused by “isolation” is limited. Our study aimed to test the hypotheses that an increase in loneliness levels would predict an increase in internalizing symptom levels and that the ability to regulate emotions may mediate these relationships. Our focus on emotion regulation strategies as a further mediator of these associations has its roots in the widely coherent literature that attests to their association with psychopathology and, more specifically, with reactions to distressing events and situations (65, 66).

The first equation structural model was based on an evaluation of all the variables at Time 1 when 1,323 participants were at the beginning of the lockdown. In this model, a significant relationship has been observed between the dimensions of loneliness, emotional dysregulation, and internalizing symptoms. Specifically, loneliness dimensions directly predicted depression, anxiety, and stress levels. This datum is in line with existing literature concerning the association between loneliness and anxiety, depression and other psychological outcomes, and even suicide (25, 67). However, if the majority of past studies focused their attention on chronic loneliness (68), in this study, we can start a reflection on the similar impact of intense and constrictive isolation.

Furthermore, we found that loneliness predicts these results in terms of depression, anxiety, and stress levels also indirectly, mediated by emotion regulation strategies. In fact, solitude, in its aspects of the intimate, social, and affiliative components, has its most distressing effect if associated with difficulties in emotion



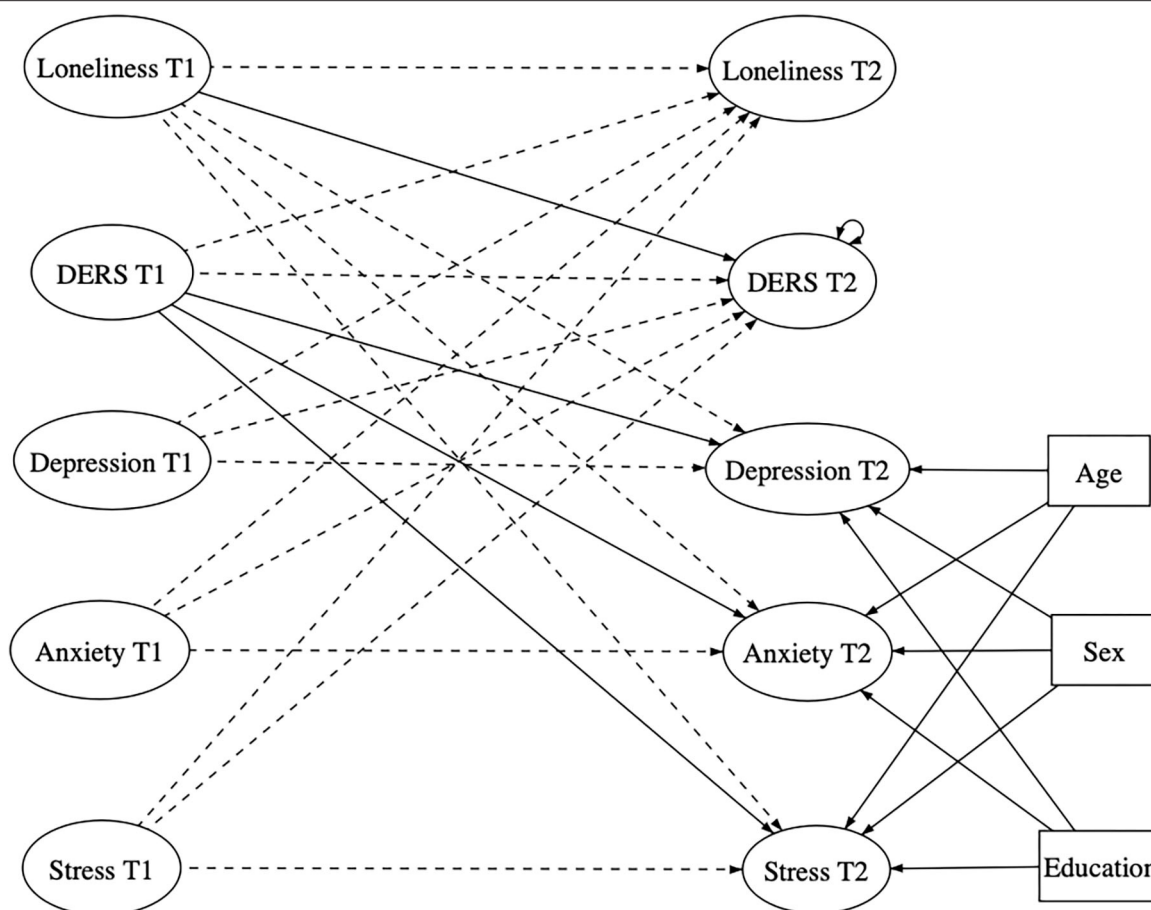


FIGURE 2 | Representation of the full tested longitudinal model. Solid lines indicate statistically hypothesized significant paths. Dashed line indicate paths inserted in the statistical mode but not expected by hypotheses. DERS, Emotion Dysregulation; T1, Scores obtained at Time 1; T2, Scores obtained at Time 2.

turn, lead to increased levels of stress (79). Thus, owning good emotion regulation capacities is likely to play a protective role in the pathways leading loneliness to stress, balancing the deprivation of interpersonal protective factors in relation to stress.

Regarding the mediating role of emotion dysregulation in the relationship between loneliness and depression, several explanations can be provided. For instance, a difficulty to accept negative emotions triggered by loneliness feelings in a non-judgmental way may lead to depressive symptoms, eliciting thoughts on the self-perceived inability to adequately face the situation. In this regard, adequate information provided by the institutions on the potential negative emotional states aroused by the situation can be of great use in legitimizing the onset of this emotion in the entire population. Furthermore, an alleged lack of self-efficacy in regulating emotions can be reasonably explained by our observations. This may be especially true of individuals with low self-efficacy in regulating emotions, who have perceived themselves as accustomed to relying on others to regulate their negative emotional states. Feeling lonely for individuals with a propensity for this emotional regulation deficit

can be particularly inspiring. In this regard, a prevention program that aims to provide some tips for regulating negative emotions can help avoid a major increase in psychological distress in the general population. Furthermore, from this perspective of understanding the associations between vulnerability factors and psychological well-being, other interesting discoveries offer ideas for further research on these topics. For example, an interesting fact concerns the role of age in the mediation of these associations. In fact, we have found significant correlations between age and outcomes in terms of depression, anxiety, and stress. Young people show multiple levels of stress during this blocking period. It can be suggested that abandoning important aspects of their daily lives for young people could be more stressful.

Other studies (80, 81) have pointed out that the closure of schools, universities, and businesses has led to negative feelings and has greatly impacted the population in terms of mental health. We could suggest that the closure of the productive sectors mentioned and also of other important sectors, e.g., cultural and sports centers and other recreational activities, have a greater impact on young people who have greater

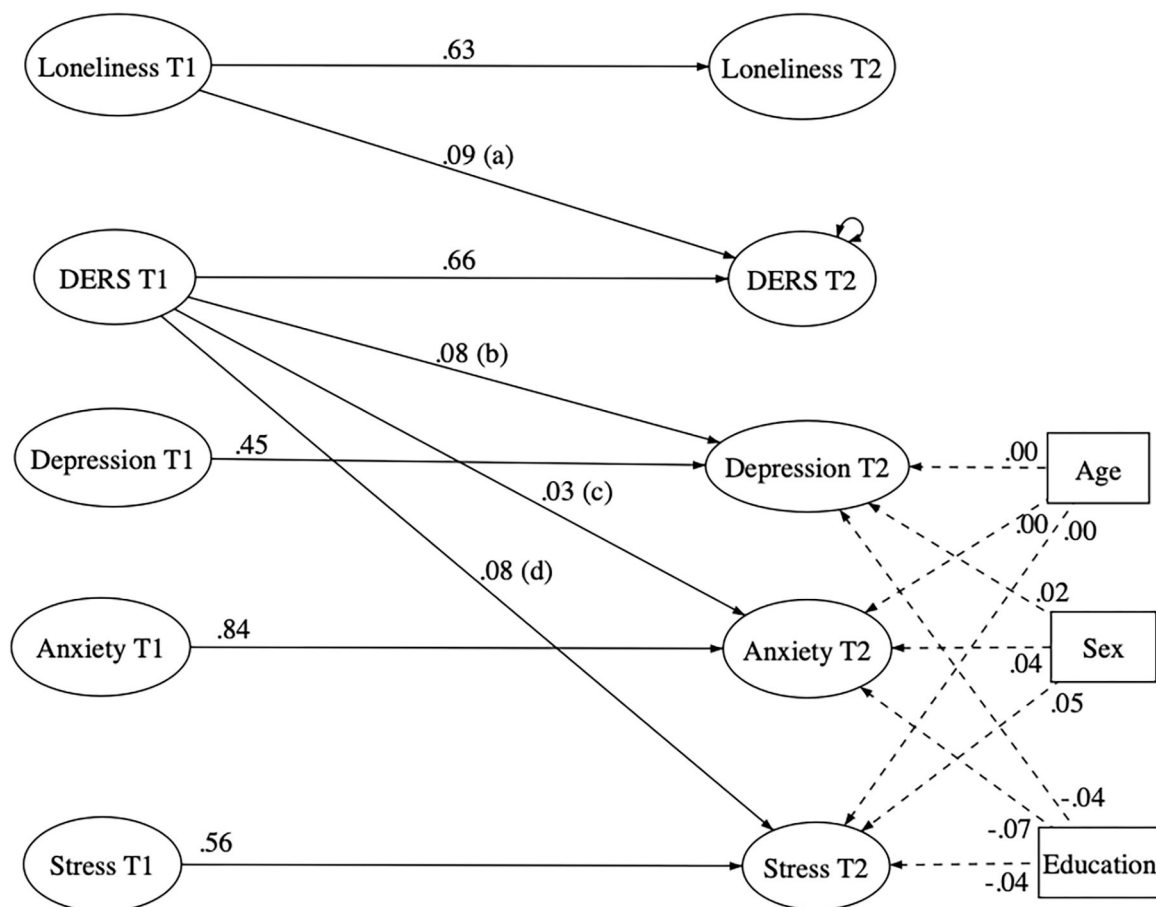


FIGURE 3 | First structural equation model testing the longitudinal mediational effect of emotion dysregulation in the relationship linking loneliness with anxiety, depression, and stress. Solid lines indicate statistically significant paths. Dashed line indicate not statistically significant paths. DERS, Emotion Dysregulation; T1, Scores obtained at Time 1; T2, Scores obtained at Time 2; a*b = 0.01 ($p = 0.043$); a*c < 0.01 ($p = 0.061$); a*d = 0.01 ($p = 0.017$).

difficulty in abandoning their previous lifestyle. However, this preliminary data need further sociodemographic insights to be better explained.

Despite the insightful nature of our findings, several limitations of the study need to be considered. First, despite longitudinal studies often suffer from relevant dropout in the participation of subjects, this issue is likely to introduce a bias in our study. Indeed, we are not aware of the reasons for dropping, and dropped participants may be more resilient or, conversely, more vulnerable to some of the mental health issues investigated in our study. This issue may limit the generalizability of our findings. Then, due to the growing research on COVID-19, we have chosen to focus attention on the general population, and we have not been able to define specific reactions between subsamples of more exposed and less exposed people. However, our idea is that it is equally important that research may focus on the most influential risk factors. In this line, as suggested by other authors (80), the possibility of capturing psychological responses to the pandemic represents itself a crucial element in identifying people who may need psychological intervention.

CONCLUSION

Overall, our results indicate the need to improve research in defining specific risk factors implicated in well-being and adjustment to this very demanding period. This could suggest implementing intervention programs aimed at improving well-being in population segments most at risk for their functioning and mental health.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Sapienza Ethics Board. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

PV and RT conceived the presented idea. SB, RC, and GR performed the analysis. All authors discussed the results and contributed to the final manuscript.

ACKNOWLEDGMENTS

Authors would like to thank the individuals and the Soletierre Foundation who generously shared their time, experience, and materials for the purposes of this project.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Global Imperative of Suicidal Ideation in 10 Countries Amid the COVID-19 Pandemic

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OPEN ACCESS

Edited by:

Richard Porter,
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Reviewed by:

Casimiro Cabrera Abreu,
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Carlo Lai,
Sapienza University of Rome, Italy

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 29 July 2020

Accepted: 10 December 2020

Published: 13 January 2021

Citation:

Cheung T, Lam SC, Lee PH, Xiang YT,
Yip PSF and the International
Research Collaboration on COVID-19
(2021) Global Imperative of Suicidal
Ideation in 10 Countries Amid the
COVID-19 Pandemic.
Front. Psychiatry 11:588781.
doi: 10.3389/fpsy.2020.588781

Background: The novel coronavirus (COVID-19) has had a detrimental impact on individuals' psychological well-being; however, a multi-country comparison on the prevalence of suicidal ideation due to the virus is still lacking.

Objectives: To examine the prevalence and correlates of suicidal ideation among the general population across 10 countries during the COVID-19 pandemic.

Materials and methods: This was a cross-sectional study which used convenience sampling and collected data by conducting an online survey. Participants were sourced from 10 Eastern and Western countries. The Patient Health Questionnaire (PHQ-9) was used to measure the outcome variable of suicidal ideation. Ordinal regression analysis was used to identify significant predictors associated with suicidal ideation.

Results: A total of 25,053 participants (22.7% male) were recruited. Results from the analysis showed that the UK and Brazil had the lowest odds of suicidal ideation compared to Macau ($p < 0.05$). Furthermore, younger age, male, married, and differences in health beliefs were significantly associated with suicidal ideation ($p < 0.05$).

Conclusions: The findings highlight the need for joint international collaboration to formulate effective suicide prevention strategies in a timely manner and the need to implement online mental health promotion platforms. In doing so, the potential global rising death rates by suicide during the pandemic can be reduced.

Keywords: suicidal ideation, COVID-19, multi-country, mental health promotion, PHQ-9 = Patient Health Questionnaire

INTRODUCTION

The 2019 novel coronavirus (COVID-19) was believed to have originated in Wuhan, China in late December 2020 and has rapidly spread to more than 200 countries nationwide (1). As of 4 June 2020, a total of 6,414,828 confirmed infected cases were recorded which resulted in 382,867 deaths (2). The global mortality rate was estimated to be 5.97%.

The rapid spread of COVID-19 has negatively affected the general population and some vulnerable subpopulations including the infected patients, their close contacts, frontline health professionals (3, 4), mentally ill individuals (5), and older adults (6, 7). The stringent infection control measures (e.g., quarantine, social distancing, lockdown, suspension of face-to-face

teaching/learning in educational institutes) initiated by the health authorities in different countries were deemed effective in containing the virus; however, these stringent preventive measures also triggered negative psychological responses including fear of contagion, anxiety, uncertainty, posttraumatic stress symptoms (6), depression (8), and at worst, suicide. Furthermore, infected and suspected cases were prone to social stigma due to being placed in quarantine and how this has been negatively portrayed by the media (9).

Unfortunately, at the time of reporting, there were still no signs of effective vaccines in treating the infection, nor were there any evidence-based control measures to curb the rapid transmission of COVID-19. Consequently, the prevalence of suicide could reach a record high as the pandemic continues to spread across different countries, which may result in a suicide pandemic (10). This suicide pandemic could further emerge as most countries are confronted with a global economic crisis. To determine the prevalence of potential suicide, one can investigate SI as it has been shown to predict suicidal attempts and other risk-taking behaviors among all age groups (11). SI refers to having destructive thoughts and plans about dying. To determine the prevalence of potential suicide, one can investigate suicidal ideation, which refers to having destructive thoughts and plans about dying, as it has been shown to predict suicidal attempts and other risk-taking behaviors among all age groups.

Nonetheless, a global picture exploring the prevalence of suicidal ideation (SI) among the general population across different countries is still lacking. This gives us the impetus to fill this research gap through the conceptualization of the present study. To the best of our knowledge, this is the first multi-national cross-sectional observational study examining the prevalence of SI and its correlates among the general population.

The aims of this study were thus to (1) examine the overall prevalence of SI and its correlates across 10 countries in the East and West, (2) examine the association between individuals' health beliefs and suicidality, and (3) provide directions for the global imperative for suicide research and prevention. We had established three hypotheses: (1) the prevalence of SI among Asian countries in the East was higher than Western countries in this study; (2) gender was a significant covariate in predicting SI; and (3) health belief was significantly associated with face mask wearing and SI in this study.

MATERIALS AND METHODS

This was a cross-sectional observational study which used convenience sampling. An online survey hyperlink was distributed to the collaborative partners to disseminate to the general population in their respective countries / regions. The sampling frame was sourced from our collaborators in 10 countries / regions nationwide (the United States of America, Canada, the United Kingdom, Brazil, Philippines, Republic of Korea, China, Turkey, Hong Kong, and Macau).

Participants, Inclusion, and Exclusion Criteria

This multi-national study targeted participants from the general population, and the eligibility criteria were: (1) aged 18 years or above; (2) male or female currently residing in a country affected by COVID-19; (3) able to read and / or understand Chinese, English, or the official language of their country of origin; and (4) capable of providing written consent. Participants who did not provide written consent and countries with <100 responses were excluded from this study.

Data Collection

The questionnaire was disseminated via several online platforms including a discussion forum, community peer groups (e.g., COVID-19 information groups, child parenting groups, working adult peer groups), and organizational or personal Facebook pages. Data collection took place from 24 March to 30 April 2020.

Measurement

Sociodemographic variables including gender, age, marital status, occupation (student or working-age adult), occupation (healthcare worker or non-healthcare worker) were solicited. Other variables including participants' frequency of using a face mask for self-protection and protecting others was also included [measured by the Face Mask Use Scale, FMUS (12)]. In addition, participants were also asked about their health beliefs which included beliefs about the susceptibility of being infected by the virus, severity toward the virus, cue to action by their governments / family members / friends, knowledge of COVID-19, and self-efficacy of wearing face masks correctly [items were applicable in the previous studies (13, 14)].

The Patient Health Questionnaire 9 (PHQ-9) was used to measure the outcome variable in this study. We used the English and Chinese version of the PHQ-9 in Western countries and Asian countries / regions, respectively. The Portuguese, Korean, and Turkish versions of the PHQ-9 were used according to the established and published version (15). The psychometric properties of the English version PHQ-9 showed satisfactory internal consistency ($\alpha = 0.83\text{--}0.92$), convergent and discriminant validity, and construct validity (exploratory factor analysis and known-group method) (16).

The PHQ-9 consisted of nine items which measured the presence and severity of self-reported depressive symptoms in the 2 weeks prior to completing the questionnaire. Each item had a response range from 0 to 3, with a summed total score ranging from 0 to 27. A score of 5–9 indicated “mild” depression, 10–14 indicated “moderate” depression, 15–19 indicated “moderately severe” depression, and ≥ 20 indicated “severe” depression. Cronbach's alpha for the internal consistency reliability of the Chinese version of the PHQ-9 was 0.86 and the correlation coefficient for the 2-weeks test–retest reliability of the scale was 0.86 (17). Cronbach's alpha for the PHQ-9 in this study was 0.91. Three countries used the translated PHQ-9 (translated according to their native language). Backward and forward translations of the sociodemographic items from English into the official

language were done for Brazil (Portuguese), Korea (Korean), and Turkey (Turkish), by the research team collaborators. Semantic equivalence and content validity were both established to ensure the appropriateness of the translations and relevance of the items.

Bias

To reduce sampling bias and yield a representative sample, all countries described as having a “High risk” or “Low risk” (2) of contracting COVID-19 were invited to participate in this study.

Sample Size

We aimed to recruit as many participants as possible over the recruitment period to improve the potential representativeness of the sample and thus did not calculate a minimum sample size a priori.

Quantitative Variables

Since our study only focused on SI, the sum total score of question nine in the PHQ-9 (18) was extracted as a composite score of our dependent variable. Question nine consisted of questions about participants’ thoughts, for example, that he / she would be better off dead, or of thinking of hurting themselves in the past 2 weeks. Participants indicated their answers on a 3-point scale, with “0:” no SI, “1:” SI for several days, “2” having SI for more than half the day, and “3” having SI nearly every day. Furthermore, higher scores indicated higher SI.

Statistical Analysis

Data analyses were performed using SPSS 25.0 for Windows (SPSS Inc., Chicago, IL, USA). Descriptive analysis, chi-square statistics, and independent sample *t*-tests were used to examine the associations between sociodemographic characteristics, face mask use, core components of the Health Belief Model (HBM), and SI. Furthermore, ordinal regression analysis was performed to identify factors which were independently associated with SI. All the significant sociodemographic characteristics, face mask use patterns, and the HBM components were entered into the regression analysis as independent variables. The level of significance was set as $p < 0.05$ (two-tailed).

RESULTS

Sociodemographic Characteristics

A total of 25,053 participants (77.3% female) were recruited, yielding a response rate of 52.8% in this study. Twelve countries participated, of which two countries (Finland and Sweden) had < 100 participants and were thus excluded from analysis. This exclusion resulted in 10 countries being included in the statistical analysis (Table 1).

The overall prevalence of SI ranged from 7.6 to 24.9% in our sample. Males exhibited higher levels of SI than females (16.6 vs. 15.4%). The youngest age group (18–24) showed the most prevalence for SI (21.8%) and there was an upward decreasing trend between age and SI. Furthermore, participants who originated from either the U.S. / Philippines accounted for the highest prevalence of suicidality (nearly every day; both

TABLE 1 | Demographic characteristics of the participants and their associations with suicide ideation ($N = 24,849$).

	Not at all	Several days	More than half the days	Nearly every day
Overall	20,958 (84.3%)	2,627 (10.6%)	824 (3.3%)	440 (1.8%)
Country/region***				
USA	570 (79.5%)	79 (11.0%)	46 (6.4%)	22 (3.1%)
Canada	436 (85.8%)	51 (10.0%)	14 (2.8%)	7 (1.4%)
UK	781 (92.4%)	51 (6.0%)	7 (0.8%)	6 (0.7%)
Brazil	7,740 (92.4%)	430 (5.1%)	83 (1.0%)	122 (1.5%)
Philippines	341 (75.1%)	80 (17.6%)	19 (4.2%)	14 (3.1%)
Republic of Korea	590 (89.7%)	40 (6.1%)	19 (2.9%)	9 (1.4%)
China	812 (84.9%)	88 (9.2%)	38 (4.0%)	18 (1.9%)
Turkey	661 (84.5%)	67 (8.6%)	32 (4.1%)	22 (2.8%)
Hong Kong	8,866 (78.0%)	1,725 (15.2%)	562 (4.9%)	215 (1.9%)
Macau	161 (86.6%)	16 (8.6%)	4 (2.2%)	5 (2.7%)
Age***				
18–24	2,216 (78.2%)	371 (13.1%)	133 (4.7%)	112 (4.0%)
25–34	5,429 (81.2%)	817 (12.2%)	296 (4.4%)	148 (2.2%)
35–44	6,484 (84.5%)	853 (11.1%)	230 (3.0%)	102 (1.3%)
45–54	3,816 (87.4%)	379 (8.7%)	124 (2.8%)	49 (1.1%)
55–64	2,142 (92.8%)	134 (5.8%)	18 (0.8%)	14 (0.6%)
65+	559 (97.0%)	14 (2.4%)	3 (0.5%)	0 (0.0%)
Sex				
Male	4,538 (83.4%)	602 (11.1%)	205 (3.8%)	94 (1.7%)
Female	16,343 (84.6%)	2,010 (10.4%)	614 (3.2%)	342 (1.8%)
Marital status***				
With partner	7,821 (81.6%)	1,157 (12.1%)	378 (3.9%)	230 (2.4%)
Without partner	13,094 (86.1%)	146 (9.6%)	445 (2.9%)	210 (1.4%)
Occupation***				
Healthcare worker	6,289 (88.3%)	571 (8.0%)	153 (2.1%)	113 (1.6%)
Non-healthcare worker	14,669 (82.8%)	2,056 (11.6%)	671 (3.8%)	327 (1.8%)

* / ** / *** significant at 5% / 1% / 0.1% level.

3.1%), followed by Turkey (2.7%), Macau (2.6%), China (1.9%), and Hong Kong (1.9%). Overall, UK participants showed the lowest prevalence of SI (0.7%), followed by South Korea / Canada (1.4%) and Brazil (1.5%).

Prevalence of Suicidal Ideation in Different Nations in Relation to Demographic Characteristics

Table 1 showed the prevalence of SI and its association with demographic factors. A total of 3,891 (15.7%) participants had reported to have SI in the last 2 weeks. The prevalence across different regions was significantly different ($p < 0.001$), the lowest at 7.6% in the UK and the highest at 24.9% in the Philippines. Younger participants, those with a partner, and non-healthcare workers showed a higher prevalence of SI ($p < 0.001$).

TABLE 2 | Face-mask wearing behavior, health belief, and their associations with suicide ideation ($N = 24,849$).

	Not at all	Several days	More than half of the days	Nearly every day
Face Mask Use (FMUS)				
Self-protection***	7.56 (3.56)	8.08 (3.09)	8.20 (3.05)	7.70 (3.74)
Protecting Others***	7.49 (4.14)	8.30 (3.48)	8.46 (3.34)	7.73 (4.04)
Total***	15.10 (7.34)	16.40 (6.24)	16.67 (6.12)	15.47 (7.46)
HBM				
Susceptibility***	3.22 (1.22)	3.23 (1.11)	3.28 (1.02)	3.56 (1.22)
Severity***	5.89 (1.61)	6.45 (1.48)	6.59 (1.51)	6.68 (1.54)
Cue***	13.90 (2.19)	13.47 (1.93)	13.18 (1.99)	13.12 (2.18)
Knowledge***	5.42 (1.20)	5.15 (1.14)	5.13 (1.20)	5.11 (1.49)
Efficacy	3.13 (0.76)	3.12 (0.66)	3.16 (0.70)	3.13 (0.81)
Total	31.56 (3.87)	31.42 (3.35)	31.33 (3.54)	31.60 (3.88)

* / ** / *** significant at 5% / 1% / 0.1% level; HBM: Health Belief Model.

Association Between Face Mask Wearing, Health Belief, and Suicidal Ideation

Table 2 showed the association between face mask wearing, health belief, and SI. Participants without any SI were less likely to wear a face mask for self-protection / others as they perceived themselves as being less susceptible to contracting COVID-19 and perceived this novel virus as not being severe, although they had been given cues to wear face masks and had good knowledge about COVID-19.

Significant Predictors Associated With Suicidal Ideation Using Ordinal Regression Analysis

Results of the ordinal regression (Table 3) confirmed the univariate comparison results and showed that relative to Macau, participants in the UK and Brazil had less frequent SI (OR = 0.38 and 0.31, respectively, $p < 0.001$). Younger, male, and participants with a partner showed higher levels of SI (all p 's < 0.05). Furthermore, face mask wearing was not associated with SI. Participants who believed that they were susceptible to the disease, perceived the disease as severe but had a low cue to action, poor knowledge of the disease, and poor efficacy to wear a mask properly, exhibited higher levels of SI ($p < 0.001$).

DISCUSSION

Age

Our results showed that the youngest age group (18–24 years) had the highest odds (OR = 5.98 95% CI 3.56, 10.03) of harboring SI compared to the oldest group (≥ 60 years old). The younger the age, the higher the likelihood of reporting SI; thus, younger age seemed to be a significant factor associated with SI. Consistent with this finding, some researchers (19) recently reported the association between COVID-19 and youth mental health. They

TABLE 3 | Ordinal regression on suicide ideation in the past 2 weeks ($n = 24,849$).

	Odds ratio (95% CI)	p-value
Country/Region		
USA	0.94 (0.58, 1.53)	0.81
Canada	0.76 (0.45, 1.27)	0.29
UK	0.39 (0.23, 0.67)	0.001
Brazil	0.32 (0.20, 0.50)	<0.001
Philippines	1.18 (0.72, 1.94)	0.51
Republic of Korea	0.72 (0.44, 1.21)	0.22
China	1.25 (0.78, 2.01)	0.36
Turkey	0.84 (0.52, 1.37)	0.49
Hong Kong	1.50 (0.96, 2.34)	0.08
Macau	Ref	
Age		
18–24	5.98 (3.56, 10.03)	<0.001
25–34	3.96 (2.38, 6.61)	<0.001
35–44	3.05 (1.83, 5.09)	<0.001
45–54	2.68 (1.60, 4.49)	<0.001
55–64	1.84 (1.08, 3.14)	<0.001
65+	Ref	
Sex		
Male	1.16 (1.06, 1.27)	0.001
Female	Ref	
Marital status		
With partner	0.70 (0.65, 0.76)	<0.001
Without partner	Ref	
Occupation		
Healthcare worker	1.03 (0.93, 1.14)	0.55
Non-healthcare worker	Ref	
Face Mask Use		
Self-protection	1.01 (0.99, 1.03)	0.21
Protecting Others	1.00 (0.98, 1.01)	0.60
Health Belief Model		
Susceptibility	1.17 (1.12, 1.21)	<0.001
Sever	1.15 (1.12, 1.19)	<0.001
Cue	0.86 (0.84, 0.88)	<0.001
Knowledge	0.92 (0.89, 0.95)	<0.001
Efficacy	0.88 (0.83, 0.93)	<0.001

Bold for P-value significant at < 0.05 .

found that 40.4% of the sampled youth ($n = 584$; 14–35 years old) were prone to psychological problems, of whom, 14.4% exhibited signs of posttraumatic stress symptoms. The high prevalence of these symptoms suggests that COVID-19 infection has a significant influence on youth mental health.

Due to suspension of face-to-face teaching in all education institutions during the pandemic, students have had to shift to online modes of learning. This sudden shift of their traditional learning mode may have led to maladaptation and increased levels of stress, anxiety, and academic pressure. In addition, students may have received less peer support due to a reduction in face-to-face interactions, being deprived of extracurricular activities (e.g., sports, gymnasium, youth centers)

and entertainment (e.g., cinemas, theme parks, playground) due to lockdown measures. The full-scale lockdown measures in some regions / countries (e.g., China, Hong Kong, Brazil, the UK, the U.S., Italy) may have led to increased levels of social isolation, entrapment, and loneliness; consequently, contributing to elevated risk of SI among the youth (20). Cultural and demographic characteristics may have also contributed to SI in the youth, as noted by Khan et al. (21) that male students from low-income families reported higher levels of academic stress and SI. Furthermore, other researchers (22) examined the association between physical activity and sedentary behavior among adolescents with suicidal vulnerability. Using the Global School-based Student Health Survey data from 206,357 students (mean age 14.6 ± 1.18 years; 51% female) in 52 low-and-middle income countries, results showed that students with high leisure activity and low sedentary behavior (≥ 3 h/day) was independently associated with higher odds of SI, whereas insufficient physical activity and high sedentary behavior was associated with higher odds of SI for both male and female adolescents.

Findings from another cross-sectional study conducted by Ahmed et al. (23) in Hubei, the epicenter of the coronavirus, found that young adults aged between 21 and 40 years had higher rates of anxiety, depression, alcohol use, and lower mental well-being during the COVID-19 pandemic. In fact, previous epidemiological studies found an association between psychiatric symptoms and suicidal tendency among survivors of the 2003 SARS epidemic (24). In other words, it has been consistently found that there is a positive correlation between infectious disease epidemics, psychiatric symptoms, and suicidal tendencies. Since the COVID-19 pandemic presents an unprecedented global public health risk, individuals residing in countries affected by this pandemic are overwhelmed with an overflow of information on the latest public health control measures to mitigate the impact of rapid transmission of this novel virus. This overflow of information and the relaying of fake news has inevitably created the “infodemic” on social media which triggers a panic state leading to SI or suicidal behavior (25). Non-schoolers / working age youth, on the other hand, may worry about their future career prospects in light of the imminent global economic recession brought on by this COVID-19 pandemic.

Gender

It was found that being male was one of the significant factors associated with SI. Compared to women, men were less likely to seek social, emotional, or professional support / counseling from others during the crisis, partly due to their hegemonic masculine beliefs (26). Due to the pandemic, several male participants were confronted with sudden loss of employment which led to increased financial burden (27) and marital discord. These male, unemployed individuals may have associated their job loss with their diminished functional role as a breadwinner in the family. Furthermore, they may have subjectively felt less valued / important by their family members and perceived themselves as a burden to the family. Furthermore, the present study found that relationship crisis, increased interfamilial conflict,

financial burden, and weakened masculine identity may also have triggered SI among male participants.

Marriage

Marital status has been identified as a risk factor for suicide in mental health research (28). This is because marriage serves a protective function by providing social support, facilitating social participation, and increasing self-esteem (29). Furthermore, marriage is associated with larger social networks (30), an increased sense of belonging (31), promoting well-being, and as a buffer against mental illness. Moreover, the Interpersonal Theory of Suicide (32) posits that the sense of belonging may also explain the relationship between marital status and suicide. This theory proposes that thwarted belongingness and perceived burdensomeness contribute to suicidal desire and suggests that harboring could be an independent predictor of SI for men (33). Among all the factors associated with SI, financial hardship was one of the strongest predictors of SI (34). Furthermore, parents' abusive / volatile behavior may indirectly be associated with adolescents' SI (35). Individuals who encountered a sudden loss of unemployment / redundancy may experience acute stress, anxiety, uncertainty, and feel as if they are a financial and psychological burden on their family members. Thus, governments are playing a pivotal role by providing timely financial safety nets (e.g., food, shelter, financial subsidy, unemployment subsidy) (10) to the vulnerable population to reduce the increased likelihood of psychiatric symptoms including post-traumatic stress disorder (PTSD), depression, and SI. Consistent with our findings, later research such as Miret et al. (36) asserted that marital status and occupational status were associated with lifetime SI in individuals aged between 18 and 49.

Health Belief

Results from the ordinal regression analysis showed that all the core components of the HBM (susceptibility, severity, cues to action, knowledge, and efficacy) were significant predictors of SI in this study (Table 3). Thus, this suggests that participants' health belief is a critical factor in determining an individual's SI. Although there was some empirical evidence supporting HBM in the domain of physical health (37), there was insufficient evidence to illustrate that health belief can also influence mental health (38). Furthermore, health belief is often linked to an individual's health literacy (39); therefore, in any pandemic, accurate and up-to-date health information should be disseminated by risk communicators of the health authority to the general population to allay public fear and anxiety. For instance, public health education on preventive measures (frequent handwashing/hand hygiene, social distancing, avoid overcrowding, face mask wearing for self-protection/ others) should be disseminated via digital online platforms, mass media, and news reports to improve the health literacy of the public. Consequently, individuals with higher levels of health literacy will improve their health behavior which is crucial to prevent the rapid transmission of the virus in the wider community. Furthermore, these individuals will take primary responsibility, action, and behavior to protect themselves / others in their primary setting to combat against the pandemic (40, 41).

It is evident that the governments of different nations have adopted different public health preventive strategies to mitigate against the rapid transmission of COVID-19. The significant variation in the mortality rate and number of suspected / confirmed COVID-19 patients between different countries / regions may reflect the determination and effectiveness of these infection control initiatives by the governments / health authorities. Inevitably, the COVID-19 pandemic has negatively impacted individual's mental health including perceived loneliness, social isolation, boredom, decreased quality of life, fear, anxiety, uncertainty, depressive symptoms, posttraumatic stress symptoms, and SI. Furthermore, the increase in suicide during the quarantine is not inevitable if appropriate measures were in place (42).

Regional Differences in Suicidal Ideation

Compared to Macau, participants in the UK and Brazil reported less SI. It is surprising to note that the UK and Brazil had lower odds of SI than that of Macau (Table 3). We speculate two reasons that could have explained this result. Firstly, Macau is a well-known country for migrant workers who have been suffering social inequities such as social isolation, overcrowded living conditions, lack of access to sanitizers, and personal protective equipment (43). They may also have difficulty obtaining health care compensation (44) and may not fully understand the pandemic situation due to language barriers and poor health literacy (45). In addition, these migrants may not be eligible to apply for the Macau government's financial subsidy and welfare benefits during this pandemic; thus, migrants in Macau may be a part of the vulnerable subpopulation who have an increased tendency to experience mental health problems which leads to increased odds of SI.

Therefore, essential COVID-19 related health information should be translated and disseminated in different languages to allay these migrants' anxiety and fear. Secondly, the variation in SI across different countries can be explained by the total government expenditure and financial resources available for their citizens. To illustrate, participants who originated from low-income countries such as Brazil and Philippines may have received limited welfare support from their governments compared to those residing in middle-to-high income countries (e.g., Hong Kong, U.S., UK, and Macau). Therefore, economic adversity alongside poor welfare support and medical benefits may increase the odds of having SI due to a lack of hope for the future during the pandemic.

Our results have shed important insights into mental / public health research during the COVID-19 pandemic and has shown that there seems to be a significant statistical difference between participants with / without SI between Macau (the East) and the UK and Brazil (the West). The variation in our prevalence estimates is likely to be attributed to different socio-cultural and economic contexts, and public health strategies in infection control, alongside government's efforts to help reduce the impact compounded by the pandemic through financial subsidy, preventive measures (mask supply, personal protective equipment), and other practical support provided to the community (10).

Despite a concerted effort across the globe, evidence from older research findings suggested that the U.S. had increased rates of suicide during the influenza pandemic between 1918 and 1919 (46) and among older adults during the 2003 SARS epidemic (5, 47). This trend is somewhat changing with youth suicide becoming more prevalent in the last few decades (48). Findings emerging from this study have provided scientific evidence that younger adults seem to have an elevated risk of suicide than older adults. Furthermore, our key findings have highlighted that there is a pressing need for implementation of contingent global mental health prevention measures and interventions for the community at large, specifically in the vulnerable subpopulations (10), *via* joint international collaboration (49). In addition, depression was found to be closely linked to suicide (50). Although depression is a treatable psychiatric disorder, it needs to be treated in a timely fashion before leading to SI.

Suicide is a complex and multifaceted phenomenon. It is evident that the COVID-19 pandemic has impacted different work sectors (27) with social distancing / quarantine measures possibly inducing loneliness, fear, anxiety, and withdrawal in some vulnerable individuals across all age groups (51).

Implications of the Study

Therefore, the WHO should establish a global mental health crisis team chaired by public health / mental health experts and epidemiologists from multidisciplinary backgrounds to establish and deliver three-tiered telehealth, telemedicine, and remote psychological counseling. With the aid of advanced digital technology, health experts can identify the most at-risk groups in the community and offer imminent assistance to reduce the global mortality burden caused by suicide. Self-guided digital interventions should be widely promoted, especially in some nations where there is restricted access to traditional health services due to lockdown / quarantine (52). Additionally, hotlines and text line support would be viable tools to mitigate against the risk of isolation and anxiety (10, 42). Furthermore, on-site visits by psychiatrists / psychologists are warranted to provide timely treatment to individuals with elevated risks of suicide.

Limitations / Generalisability

There are several limitations that need to be addressed in this study. First, a cross-sectional study cannot infer any causal relationship between variables and thus, may reduce the generalisability of our findings. Second, some countries with a high or low risk of COVID-19 infections could not participate in this study due to the lengthy ethical approval process which inevitably reduced the representativeness of our sample. Third, some variables (monthly household income, educational attainment, number of children) were not solicited in this study; thus, we could not examine the association between these demographic characteristics with SI. Lastly, owing to the sudden surge of the pandemic emerging in the East before its rapid spread to the Western countries, use of stratified random sampling was almost impossible in this multi-national collaborative

study. Therefore, future researchers should consider these factors when investigating the impact of SI and COVID-19 in future studies.’

CONCLUSION

This study found that SI was prevalent among the younger age groups as well as in male, married individuals across all the collaborative countries / regions. Furthermore, health belief was significantly associated with SI during the COVID-19 pandemic; thus, joint international collaboration by key stakeholders and policymakers is warranted to formulate timely and effective suicide prevention measures and mental health promotion initiatives. In doing so, the global risk of increasing psychiatric morbidity and rising mortality rates brought on by this pandemic can be reduced.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by several regional committees, including Human Subjects Ethics Sub-committee of the Hong Kong Polytechnic University (reference no: HSEARS20200227002-01), the National Committee of Ethics Research (CONEP) (CAAE: 30572120.0.0000.0008; Opinion 3.971.512), Medical Sciences Interdivisional Research Ethics Committee, University of Oxford (R69446/RE001), Delegated Research Ethics Review Committee, and York University (File # 2020103). The patients/participants provided their written informed consent to participate in this study.

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SL and TC: conception and design of the study and drafting the manuscript. SL and the International Research Collaboration on COVID-19: acquisition of data. SL, PL, TC, and the International Research Collaboration on COVID-19: data analysis. SL, PL, and TC: interpretation of data. YX and PY: critically review. All authors contributed to the article and approved the submitted version.

FUNDING

This project has been partially funded by the Brazilian National Council for Scientific and Technological Development (CNPq, Portuguese: Conselho Nacional de Desenvolvimento Científico e Tecnológico) (ref: 401371/2020-4).

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ACKNOWLEDGMENTS

We are grateful to those international collaborators who have coordinated and facilitated the overall logistics and execution of this study. We would also like to thank all the participants who took part in this study.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The Mental Well-Being of Frontline Physicians Working in Civil Wars Under Coronavirus Disease 2019 Pandemic Conditions

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 25 August 2020

Accepted: 04 December 2020

Published: 14 January 2021

Citation:

Elhadi M, Msherghi A, Elgzairi M, Alhashimi A, Bouhuwaish A, Biala M, Abuelmeda S, Khel S, Khaled A, Alsoufi A, Elhadi A and BenGhatnsh A (2021) The Mental Well-Being of Frontline Physicians Working in Civil Wars Under Coronavirus Disease 2019 Pandemic Conditions. *Front. Psychiatry* 11:598720. doi: 10.3389/fpsy.2020.598720

Background and Objective: Emergency medical physicians are regarded as essential frontline staff in combating the coronavirus disease 2019 (COVID-19) pandemic. These health-care workers are faced with significant stressors in addition to the usual stress felt in their regular work. Therefore, this study aimed to examine the prevalence of anxiety, depression, and burnout among emergency physicians on the frontline of the COVID-19 pandemic.

Method: Using a cross-sectional study methodology, we surveyed physicians active on April 2020 to study depression and anxiety [using Hospital Anxiety and Depression Scale (HADS)] and burnout [using the Abbreviated Maslach Burnout Inventory (aMBI) scale].

Results: A total of 154 emergency physicians completed the survey. We found that about 65.6% of patients were experiencing anxiety (based on a HADS score ≥ 11), and 73.4% were displaying depressive symptoms. For burnout, three subscales indicated that 67.5% endured emotional exhaustion, and 48.1% experienced depersonalization (defined as a score of ≥ 10 on aMBI). A total of 21.4% of respondents perceived a sense of personal underachievement, defined as a score of <10 via aMBI.

Conclusion: Physicians' psychological status is crucial and plays a major role in their well-being, affecting their work satisfaction. Therefore, implementing strategies aimed at decreasing the impact of stressful events is crucial to alleviate the distress experienced by physicians on the frontline of the COVID-19 pandemic.

Keywords: COVID-19, depression, anxiety, burnout, pandemic, pandemic (COVID-19)

INTRODUCTION

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was identified in late 2019 in Wuhan, China, as the cause of numerous severe viral pneumonia cases (1). On February 11, 2020, the World Health Organization (WHO) designated the name "COVID-19" (coronavirus disease 2019) for the viral pneumonia caused by SARS-CoV-2 (2). In the wake of the announcement, the virus reached pandemic levels, resulting in more than 54 million cases worldwide and more than 1,300,000 deaths by November 15, 2020 (3).

Emergency medical physicians are regarded as frontline staff in combating the COVID-19 pandemic. They are the first contact point for any patients who display signs and symptoms of COVID-19 infection. This is in addition to the usual stress felt by emergency physicians during their work (4).

Previous studies have reported that burnout (a state of emotional exhaustion resulting in the loss of enthusiasm for one's work) and depersonalization (a feeling of cynicism accompanied by a low sense of personal accomplishment) are signs of mental health deterioration. This deterioration has negative consequences for a physician's ability to judge, diagnose, and deliver satisfactory health-care services for their patients (5–7). Furthermore, it has been reported that burnout and high emotional pressure can increase the rates of both medical error and substance abuse; the literature has even indicated an increase in risk of suicide (7–11).

Several studies have investigated the prevalence of psychological distress experienced by health-care workers during the COVID-19 pandemic. However, none have focused on emergency physicians, although they are the first line (12–18), and no studies have been conducted in African regions.

Therefore, understanding the causes and effects of stress and its consequences is critical for the well-being of emergency doctors, as stress and emotional pressure can have negative and deleterious consequences on physicians' well-being and their ability to deliver appropriate health-care services to their patients (19, 20).

Libya, like a number of other countries, is suffering from civil war and financial crises, increasing the risk of mental dysfunction and mental disorders such as depression, anxiety, and burnout (21–23).

Furthermore, the scientific literature lacks data concerning the rate of burnout among emergency physicians, especially those deployed during the COVID-19 pandemic. Including our present knowledge of the state of the literature, there is no recent study concerning emergency physicians' mental status as impacted by the COVID-19 pandemic and foregrounded by civil war. Therefore, in this study, we aimed to examine the prevalence of anxiety, depression, and burnout among emergency physicians dealing with the COVID-19 pandemic on the frontlines.

MATERIALS AND METHODS

Study Design and Setting

This study employed a cross-sectional study methodology.

Selection of Participants

Between April 18 and 28, 2020, we recruited health-care workers from Libyan hospitals. We only included emergency physicians working during the COVID-19 pandemic. Emergency physicians in Libya are responsible frontline health-care workers for many diseases and conditions such as acute care, urgent toxicological and psychiatric cases, and trauma triage; severe respiratory and cardiovascular disease patients who usually present to the emergency department initially; and suspected COVID-19 patients who have typical COVID-19 symptoms. Therefore, they are at increased risk of contracting a COVID-19 infection and

have a higher risk of complex disease. Along with their life risk, as they treat injured and severely disabled war victims and militias, they are usually at higher risk of abuse by militias or their relatives. Our exclusionary criteria comprised those health-care workers who were either retired or on leave during this period, so that they were not involved in the care of patients during the COVID-19 pandemic. We also excluded those with a preexisting mental illness or who failed to complete the psychological data.

Measurements

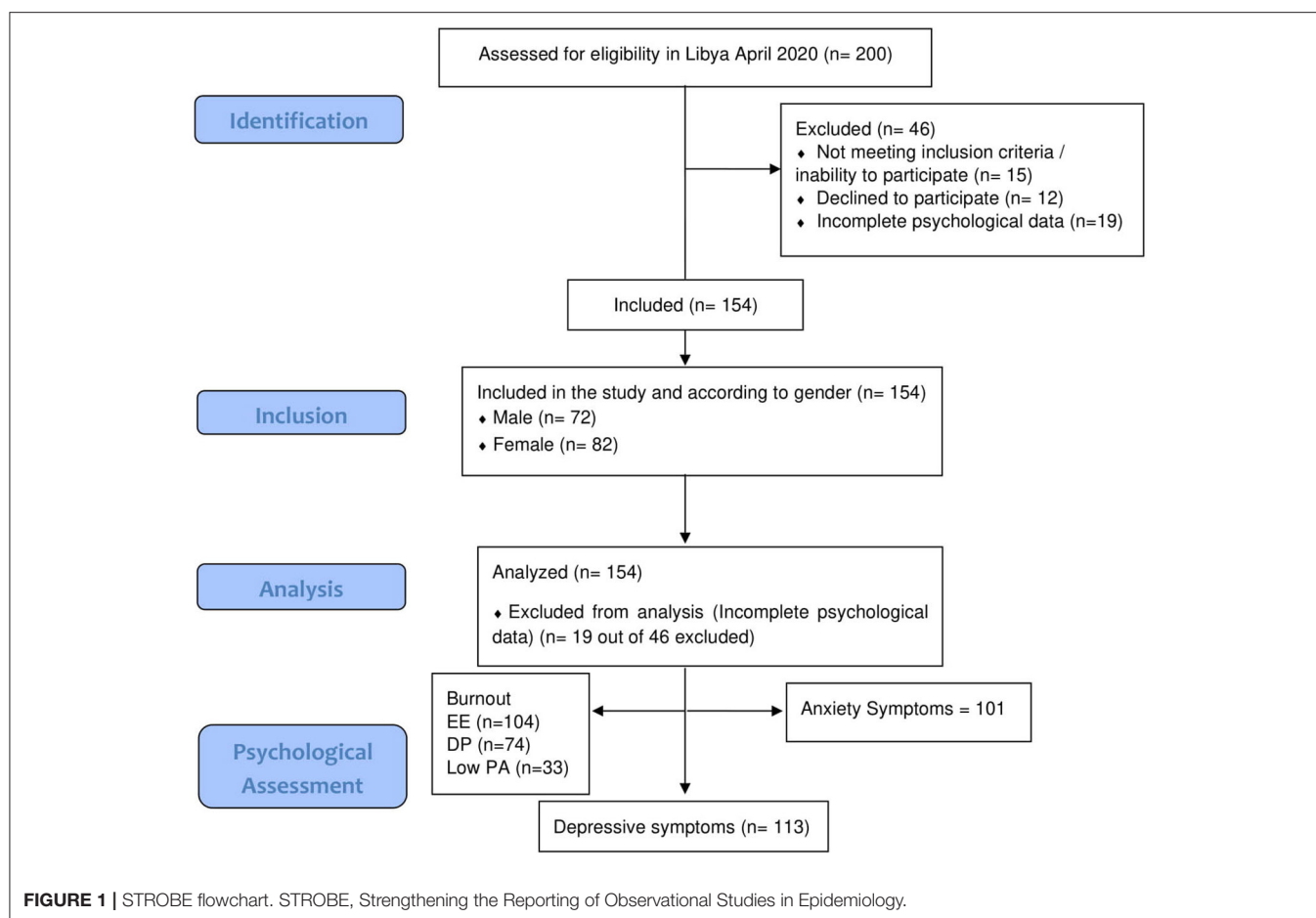
Data were collected via a specially designed questionnaire distributed by paper, mobile messaging, and email. The questionnaire consisted of the following categories: demographic and socioeconomic data, mental health assessment, risk of civil war assessment of violence, and assessment of depression and anxiety. Several relevant questions were also chosen to address the prevalence of violent acts enacted against health-care workers and whether such acts were associated with an increase in the risk of depression and anxiety.

Outcomes and Definition of Outcomes

The Hospital Anxiety and Depression Scale (HADS) was used to measure the prevalence of anxiety and depression among health-care workers (24). The HADS was validated in a previous study as having a mean of 0.83 (Cronbach's alpha) across several languages and different settings, with a sensitivity and specificity of 0.8 (25). The HADS's corresponding questionnaire consists of 14 self-reported items: seven questions concerning anxiety and seven concerning depression. According to Zigmond and Snaith, a score of <7 is considered normal, a score of 8–10 indicates borderline or doubtful cases, and a score of ≥ 11 indicates definite cases (26).

The second section employed the Abbreviated Maslach Burnout Inventory (aMBI), a nine-item scale used to assess the level of burnout among physicians (27–30). The inventory has three subscales: emotional exhaustion (EE—emotional depletion due to the demands of the job and continuous work-related stress), depersonalization (DP—an impersonal response toward service recipients), and personal accomplishment (PA—the degree of personal competence, achievement, and satisfaction with one's work). The three elements of the subscale were assessed, along with the three items. A seven-point Likert scale ranging from never (0) to every day (6) was used for each item. Therefore, the cumulative score of each subscale ranges from a minimum of 0 to a maximum of 18, which is calculated for each health-care worker surveyed.

For emotional exhaustion and depersonalization, higher scores indicate greater levels of burnout; for personal achievement, the scale is inverted. The internal reliability of each subscale was calculated using Cronbach's alpha coefficient (31, 32). For EE and DP, a subscale score of 0–9 is categorized as “no to low burnout,” whereas a subscale score of 10–18 is regarded as “moderate to severe burnout”; for PA, the scale is inverted.



The reporting of the study follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement (33). See flowchart in **Figure 1**.

Statistical analysis was performed using IBM's SPSS Statistics package for Windows (Version 25.0). Frequency, means, and standard deviations were used to describe the data. Chi-square tests were used to compare the categorical variables, while independent *t*-tests were used to compare continuous variables. Ethical approval for this study was obtained from the Bioethics Committee at the Biotechnology Research Center in Libya.

RESULTS

Characteristics of Study Subjects

A total of 154 out of 200 emergency physicians completed the survey, resulting in an estimated 77% response rate; 53.2% of respondents were female. The mean age of emergency physicians surveyed was 31.66 ± 5.97 , with $\sim 92.2\%$ of respondents falling below the age of 40 years. About half (51.9%) of the respondents were emergency doctor residents working only within government departments. The majority (69.5%) had < 5 years of clinical experience. In terms of the length of their work week, we found that participants worked an approximate mean of 52.95 ± 9.71 h/week, with a mean of 3.68 ± 0.685 night shifts per

month for emergency physicians. **Table 1** provides an overview of the basic characteristics of emergency medicine physicians who participated in the study.

Main Results

With respect to the prevalence of anxiety and depression, our data based on the HADS indicated that $\sim 65.6\%$ of subjects ($n = 101$) were experiencing anxiety (those who received a score ≥ 11), and about 73.4% of subjects ($n = 113$) were experiencing depressive symptoms (those who received a score ≥ 11). Our data demonstrated that 67.5% ($n = 104$) of subjects suffered from emotional exhaustion, while 48.1% ($n = 74$) experienced depersonalization (both derived from scores of ≥ 10 out of 18 on the aMBI). However, for low personal accomplishment (PA), only 21.4% ($n = 33$) scored < 10 (indicating burnout for this category).

About 46.1% ($n = 71$) of respondents had encountered at least one episode of verbal abuse, while 12.3% ($n = 19$) had experienced physical abuse.

Tables 2–4 depict the association between the basic characteristics and occurrences of anxiety, depression, and burnout among emergency physicians. With the use of a univariate analysis, a comparison between the groups of physicians experiencing anxiety (HADS anxiety ≥ 11) and depression (HADS depression ≥ 11) demonstrated the following

TABLE 1 | Basic characteristics of emergency medicine physicians ($n = 154$).

Variables	Counts $n = 154$	Proportions (%)
Age range		
- <40	142	92.2
- ≥ 40	12	7.8
Gender		
- Male	72	46.8
- Female	82	53.2
Marital status		
- Married	59	38.3
- Not married (including single, divorced, and widowed)	95	61.7
Residency		
- Live with family	100	64.9
- Live alone	54	35.1
Employment sector		
- Governmental only	80	51.9
- Private only	21	13.6
- Both	53	34.4
Years of experience		
- <3 years	73	48.1
- 3–5 years	33	21.4
- 5–15	38	24.7
- >15 years	9	5.8
Smoking		
- Yes	27	17.5
- No	127	82.5
Illicit drug use		
- Yes	8	5.2
- No	146	94.8
Internally displaced		
- Yes	46	29.9
- No	108	70.1
Transport issues		
- Yes	57	37
- No	97	63
Verbal abuse		
- Yes	71	46.1
- No	83	53.9
Physical abuse		
- Yes	19	12.3
- No	135	87.7

elements to be statistically significant: for anxiety, only age range, working hours per week, and transport issues were associated with a higher prevalence of anxiety ($p < 0.05$); however, for depression, none of the demographic and clinical characteristics were significantly associated with a higher prevalence of depression among groups (Table 3).

For burnout syndrome, working hours per week, residency status, and transport issues were all significantly associated with a higher rate of emotional exhaustion. Meanwhile, none of the variables were significantly associated with depersonalization, indicating a similar distribution between the categorical groups.

TABLE 2 | Summary of anxiety, depression, and burnout among emergency physicians ($n = 154$).

Category	Grade	Mean $\pm$ SD	Count	Percent
Depression	Total	12.39 $\pm$ 2.95	154	100.0
	Normal (0–7)		7	4.5
	Borderline abnormal (8–10)		34	22.1
	Abnormal depressive case (11–21)		113	73.4
Anxiety	Total	11.91 $\pm$ 3.81	154	100.0
	Normal (0–7)		21	13.6
	Borderline abnormal (8–10)		32	20.8
	Abnormal anxiety case (11–21)		101	65.6
Burnout	Emotional exhaustion (EE) ≥ 10	11.2 $\pm$ 5.15	104	67.5
	Depersonalization (DP) ≥ 10	8.55 $\pm$ 5.08	74	48.1
	Low personal accomplishment (PA) < 10	12.61 $\pm$ 3.89	33	21.4

However, lower personal accomplishment was statistically associated with respondents' years of experience: those with <3 years had higher self-accomplishment, as compared with those with 3–5 years of experience, who perceived themselves as achieving less self-accomplishment. Table 4 demonstrates these differences.

LIMITATIONS

This study has several limitations. First, the sample size allows the study to focus only on one war-torn country, which may have several additional and unique factors that may contribute to high levels of mental distress. These aspects may, in turn, aggravate the effects of the COVID-19 pandemic. Furthermore, interviewer bias may be present, as some respondents may opt to hide or alter their responses out of a fear of stigmatization, despite the anonymous nature of the survey. Additionally, due to the cross-sectional study design, a lower causation and linkage ability may be apparent. In light of these limitations, further studies are required to account for the potential impact of such factors. Moreover, we used self-report evaluation questionnaires that could provide for the level of symptoms; however, they are not used for psychiatric diagnoses and evaluations, which require specific instruments and proper diagnostic methods. To date, no previous studies have focused on emergency physicians residing in countries with civil wars and their mental status during the COVID-19 pandemic.

DISCUSSION

This study demonstrated higher than expected levels of anxiety, depression, and burnout among 154 emergency doctors from Libya who worked during the COVID-19 pandemic and civil war crisis. Of the respondents, 65.6% reached the cutoff score for anxiety, whereas more than 73% reached the cutoff score for depression. Regarding burnout,

TABLE 3 | Association of depression and anxiety with other characteristics of participants.

Variables	Total	Anxiety (+)	Anxiety (–)	p-value	Depression (+)	Depression (–)	p-value
Total prevalence, n (%)	154	101 (65.6)	53 (34.4)		113 (73.4)	41 (26.6)	
Age range				0.014*			0.22
- <40	142	97 (96)	45 (84.9)		106 (93.8)	36 (87.7)	
- ≥40	12	4 (4)	8 (15.1)		7 (6.2)	5 (12.2)	
Gender				0.678			0.761
- Male	82	46 (45.5)	26 (49.1)		52 (46)	20 (48.8)	
- Female	72	55 (54.5)	27 (50.9)		61 (54)	21 (51.2)	
Working hours per week, mean ± SD	52.95 ± 9.71	53.36 ± 10.89	52.19 ± 6.98	0.029*	52.73 ± 10.18	53.56 ± 8.37	0.164
Night shifts per month, mean ± SD	3.68 ± 0.68	3.65 ± 0.69	3.72 ± 0.66	0.466	3.65 ± 0.72	3.73 ± 0.549	0.067
Marital status				0.915			0.39
- Married	95	39 (38.6)	20 (37.7)		41 (36.3)	18 (43.9)	
- Not-married (including single, divorced, and widowed)	59	62 (61.4)	33 (62.3)		72 (63.7)	23 (56.1)	
Residency				0.835			0.812
- Live with family	100	36 (35.6)	35 (66)		74 (65.5)	26 (63.4)	
- Live alone	54	65 (64.4)	18 (34)		39 (34.5)	15 (36.6)	
Employment sector				0.929			0.976
- Governmental only	80	53 (52.5)	27 (50.9)		59 (52.2)	21 (51.2)	
- Private only	21	13 (12.9)	8 (15.1)		15 (13.3)	6 (14.6)	
- Both	53	35 (34.7)	18 (34)		39 (34.5)	14 (34.1)	
Years of experience				0.219			0.806
- <3 years	74	50 (49.5)	24 (45.3)		56 (49.6)	18 (43.9)	
- 3–5 years	33	22 (21.8)	11 (20.8)		25 (22.1)	8 (19.5)	
- 5–10 years	38	26 (25.7)	12 (22.6)		26 (23)	12 (29.3)	
- >15 years	9	3 (3)	6 (11.3)		6 (5.3)	3 (7.3)	
Smoking				0.227			0.178
- Yes	27	86 (85.1)	12 (22.6)		17 (15)	10 (24.4)	
- No	127	15 (14.9)	41 (77.4)		96 (85)	31 (75.6)	
Illicit drug use				0.85			0.915
- Yes	8	5 (5)	3 (5.7)		6 (5.3)	2 (4.9)	
- No	146	96 (95)	50 (94.3)		107 (94.7)	39 (95.1)	
Internally displaced				0.758			0.764
- Yes	46	31 (30.7)	15 (28.3)		33 (29.2)	13 (31.7)	
- No	108	70 (69.3)	38 (71.7)		80 (70.8)	28 (68.3)	
Transport issues				0.02*			0.657
- Yes	57	44 (43.6)	13 (24.5)		43 (38.1)	14 (34.1)	
- No	97	57 (56.4)	40 (75.5)		70 (61.9)	27 (65.9)	
Verbal abuse				0.242			0.487
- Yes	71	50 (49.5)	21 (39.6)		54 (47.8)	17 (41.5)	
- No	83	51 (50.5)	32 (60.4)		59 (52.2)	24 (58.5)	
Physical abuse				0.427			0.557
- Yes	19	14 (13.9)	5 (9.4)		15 (13.3)	4 (9.8)	
- No	135	87 (86.1)	48 (90.6)		98 (86.7)	37 (90.2)	

The definitive diagnosis of depression or depression was defined as a score of 11–21 on the HADS inventory.

*Significant at $p < 0.05$.

about two-thirds (67%) of subjects had emotional exhaustion, while about half (48%) experienced depersonalization, and about 21.4% perceived themselves as having a low level of personal/self-accomplishment.

A higher prevalence and scores of anxiety, depression, and burnout were generally not statistically associated with demographic features. The wider distribution of depression, anxiety, and burnout, despite such differences, can carry

TABLE 4 | Association of burnout with other characteristics of participants.

Variables	Total	EE (+)	EE (–)	p-value	D (+)	D (–)	p-value	PA (low)	PA (high)	p-value
Total prevalence, n (%)	154	104 (67.5)	50 (32.5)		74 (48.1)	80 (51.9)		33 (21.4)	121 (78.6)	
Age range				0.177			0.645			0.075
- <40	142	98 (94.2)	44 (88)		69 (93.2)	73 (91.3)		28 (84.8)	114 (94.2)	
- ≥40	12	6 (5.8)	6 (12)		5 (6.8)	7 (8.8)		5 (15.2)	7 (5.8)	
Gender				0.412			0.081			0.866
- Male	82	51 (49)	21 (42)		40 (54.1)	32 (40)		15 (45.5)	57 (47.1)	
- Female	72	53 (51)	29 (58)		34 (45.9)	48 (60)		18 (54.4)	64 (52.9)	
Working hours per week, mean ± SD	52.95 ± 9.71	53.53 ± 11.07	51.76 ± 5.92	0.001*	53.89 ± 10.67	52.09 ± 8.27	0.087	53.36 ± 6.65	52.84 ± 10.42	0.102
Night shifts per month, mean ± SD	3.68 ± 0.68	3.70 ± 0.736	3.62 ± 0.56	0.612	3.68 ± 0.57	3.68 ± 0.77	0.125	3.73 ± 0.517	3.66 ± 0.72	0.089
Marital status				0.174			0.654			0.885
- Married	95	36 (34.6)	23 (46)		27 (36.5)	32 (40)		13 (39.4)	46 (38)	
- Not married (including single, divorced, and widowed)	59	68 (65.4)	27 (54)		47 (63.5)	48 (60)		20 (60.6)	75 (62)	
Residency				0.049*			0.986			0.318
- Live with family	100	73 (70.2)	27 (54)		48 (64.9)	52 (65)		19 (57.6)	81 (66.9)	
- Live alone	54	31 (29.8)	23 (46)		26 (35.1)	28 (35)		14 (42.4)	40 (33.1)	
Employment sector				0.719			0.15			0.192
- Governmental only	80	52 (50)	28 (56)		33 (44.6)	47 (58.8)		21 (63.6)	59 (48.8)	
- Private only	21	14 (13.5)	7 (14)		10 (13.5)	11 (13.8)		5 (15.2)	16 (13.2)	
- Both	53	38 (36.5)	15 (30)		31 (41.9)	22 (27.5)		7 (21.2)	46 (38)	
Years of experience				0.039*			0.258			0.001*
- <3 years	74	54 (51.9)	20 (40)		40 (54.1)	34 (42.5)		9 (27.3)	65 (53.7)	
- 3–5 years	33	17 (16.3)	16 (32)		11 (14.9)	22 (27.5)		14 (42.4)	19 (15.7)	
- 5–15	38	29 (27.9)	9 (18)		19 (25.7)	19 (23.8)		6 (18.2)	32 (26.4)	
- >15 years	9	4 (3.8)	5 (10)		4 (5.4)	5 (6.3)		4 (12.1)	5 (4.1)	
Smoking				0.424			0.39			0.912
- Yes	27	20 (19.2)	7 (14)		15 (20.3)	12 (15)		6 (18.2)	21 (17.4)	
- No	127	84 (80.8)	43 (86)		59 (79.7)	68 (85)		27 (81.8)	100 (82.6)	
Illicit drugs use				0.643			0.91			0.8
- Yes	8	6 (5.8)	2 (4)		4 (5.4)	4 (5)		2 (6.1)	6 (5)	
- No	146	98 (94.2)	48 (96)		70 (94.6)	76 (95)		31 (93.9)	115 (95)	
Internally displaced				0.981			0.307			0.951
- Yes	46	31 (29.8)	15 (30)		25 (33.8)	21 (26.3)		10 (30.3)	36 (29.8)	
- No	108	73 (70.2)	35 (70)		49 (66.2)	59 (73.8)		23 (69.7)	85 (70.2)	

(Continued)

TABLE 4 | Continued

Variables	Total	EE (+)	EE (-)	p-value	D (+)	D (-)	p-value	PA (low)	PA (high)	p-value
Transport issues				0.002			0.124			0.368
- Yes	57	47 (45.2)	10 (20)		32 (43.2)	25 (31.3)		10 (30.3)	47 (38.8)	
- No	97	57 (54.8)	40 (80)		42 (56.8)	55 (68.8)		23 (69.7)	74 (61.2)	
Verbal abuse				0.162			0.057			0.632
- Yes	71	52 (50)	19 (38)		40 (54.1)	31 (38.8)		14 (42.4)	57 (47.1)	
- No	83	52 (50)	31 (62)		34 (45.9)	49 (61.2)		19 (57.6)	64 (62.9)	
Physical abuse				0.541			0.159			0.522
- Yes	19	14 (13.5)	5 (10)		12 (16.2)	7 (8.8)		3 (9.1)	16 (13.2)	
- No	135	90 (66.5)	45 (90)		62 (83.8)	73 (91.2)		30 (90.9)	105 (86.8)	

Emotional exhaustion (EE) ≥ 10 , depersonalization (D) ≥ 10 , low personal accomplishment (PA) < 10 , and high personal accomplishment ≥ 10 .

*Significant at $p < 0.05$.

dangerous risks related to mental status deterioration, substance abuse, low self-esteem, lower patient care, job dropout or attrition from training, lower sleep quality, a decrease in work satisfaction, and suicidal risks (34–38). Abuse, either verbal or physical, was not significantly different between the groups, as they were exposed to similar risks. The number of working hours per week, however, was associated with emotional exhaustion (as an element of burnout) and anxiety ($p < 0.05$).

This study reveals a very demanding image of the mental health status of emergency physicians working as frontline staff during the COVID-19 pandemic, as foregrounded by civil war (39). It uncovers the prevalence of major mental health disorders, such as anxiety, depression, and burnout, among frontline staff. The female gender was strongly associated with a higher risk of major mental disorders, including general anxiety disorder or mood disorders and post-traumatic stress disorders, mainly in contexts characterized by civil war conflict. However, we found that women with higher degrees of burnout and depressive and anxiety symptoms were not statistically significant. Nevertheless, higher rates of mental disorders were usually associated with women, and there is a high demand for further studies on both health-care workers and the general population in Libya, with an emphasis on other indicators such as post-traumatic stress disorders and severe depressive and anxiety disorders (40, 41).

According to a previous systemic review and meta-analysis of more than 54 studies, the prevalence of depression (between 20.9 and 43.2%) was noted among the studies, based on the characteristics and tools used in depression screening (42). However, our study suggests a 73.4% prevalence of depression, which is higher than in previous studies. Various causes may explain this, such as the public health situation in Libya, which is lacking in social and psychiatric support, and the permeation of civil war and financial crisis in the country, which places a greater burden on physicians who must care for their families while risking death or injury in the war.

In terms of the current COVID-19 situation, the following are some potential reasons for the increase in observed depression: the risk of contamination of health-care workers, the risk of transmitting the infection to family members, a shortage of personal protective equipment (reported as a possible cause of distress), and the lack of adequate training and treatment for COVID-19 management. These are all major stressors that can put physicians at a higher risk for mental distress and produce higher rates of depression, anxiety, and, possibly, burnout syndrome (43–46). Moreover, health-care workers are experiencing additional stressors specific to their jobs, such as work-related stress (e.g., task-specific stressors), working hours, family pressures, the need for specialty training, and a large number of shifts (47).

A study conducted in China by Lai et al. (13) found a 50.4% prevalence of depressive symptoms and a 44.6% prevalence of anxiety using the Patient Health Questionnaire-9 (PHQ-9) tool during the early weeks of the COVID-19 pandemic. Another study conducted by (48) of health-care workers in Spain found a 55.89% prevalence for depressive symptoms and a 67.55% prevalence for anxiety symptoms using the 21-item version of the Depression Anxiety Stress Scales. Their results were similar

to our results. Another large study among 5,062 health workers in China found 13.5% depressive symptoms and 24.1% anxiety symptoms using both PHQ-9 and Generalized Anxiety Disorder-7 (GAD-7); the study included 1,004 physicians, 3,417 nurses, and 641 technicians from different specialties (49). However, most of the recently published studies in the literature have focused on general health-care workers, without a specific focus on emergency physicians, who are regarded as frontline physicians during the COVID-19 pandemic.

Our study displayed higher rates of anxiety, depression, and burnout prevalence compared with previously published literature. A study of emergency physicians in Libya before the COVID-19 pandemic found that 45.4% had anxiety symptoms, and the same percentage had depressive symptoms (50). However, we found a higher prevalence in our current study, with anxiety symptoms in 65.6% of patients and depressive symptoms in 73.4%, which may be attributed to the COVID-19 pandemic and an increase in the rate of civil war conflict in early 2020. Another study conducted among physicians of many specialties in Libya found that 56.3% of the participants had depressive symptoms and 46.7% had anxiety symptoms (50). These results show that emergency physicians are at a higher risk of depressive and anxiety symptoms than other medical specialties during the COVID-19 pandemic.

The high prevalence of depression, anxiety, and burnout is a major concern for physicians' well-being and career progress. Several studies have suggested that depression and burnout can carry further risk, progressing chronically throughout a physician's life (51–53). It should also be emphasized that psychological distress and mental fatigue can affect a person's work performance, increasing the risk of medical error, which not only affects physicians but also has adverse effects on the quality of care for patients. This presents a potentially catastrophic effect on the health-care system, increasing the risk for patients as physicians attempt to decrease their working hours or change careers to find less stressful employment (54–56). Burnout affects physicians' and patients' personal lives and has many negative consequences for healthcare-related issues, such as physicians becoming less interested in their work and experiencing mental fatigue, which increases the probability of diagnostic errors, leads to unsafe patient environments, and puts physicians at higher risk of psychological trauma (56).

Several interventions have been suggested as means to decrease the distress experienced by physicians at work, such as the following: use of technology as a reminder to initiate meditation to reduce burnout (57); use of the positive and negative reinforcement strategy outlined by Ratliff et al. which

describes the effect of praise on reducing a part of burnout (58); and art therapy, as described by King et al. (59), whereby physicians paint or decorate artistic images, potentially decreasing stress and burnout by focusing on creative outlets. Another interesting approach that could decrease stress is the use of exergame-based rehabilitative interventions that have been proven effective in improving health-related quality of life in chronic diseases (60). Organizational well-being has been proposed as a new method of promoting the psychosomatic health of workers, whereby mental health services are provided in the workplace to health-care workers, based on health system management plans (61).

CONCLUSION

Our study indicates that the prevalence of depression, anxiety, and burnout is higher than that reported in previous studies. Physicians' psychological status is crucial and plays a major and influential role in the well-being of health-care workers. An emergency physician's psychological status can affect their work satisfaction; therefore, implementing strategies aimed at decreasing stressful events is crucial in alleviating the distress experienced by physicians on the frontline of the COVID-19 pandemic. These issues will continue to affect those who are on the frontline; therefore, it is essential to work on mental support and services to alleviate their manifestations in the current situation, which is worsening in the country as a result of the ongoing civil war.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Biotechnology Research Center in Libya. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

ME, AM, and ME analyzed and interpreted the patient data. ME supervised the project. ME wrote the first draft of the manuscript. All authors contributed to the study design, data collection, read, and approved the final manuscript.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Theoretical Mapping of Suicidal Risk Factors During the COVID-19 Pandemic: A Mini-Review

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OPEN ACCESS

Edited by:

Carlo Lai,

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Reviewed by:

Narendra Singh Thagunna,

Tribhuvan University, Nepal

Swati Akshay Sachdeva,

Sikkim University, India

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 31 July 2020

Accepted: 09 December 2020

Published: 22 January 2021

Citation:

Raj S, Ghosh D, Singh T, Verma SK
and Arya YK (2021) Theoretical
Mapping of Suicidal Risk Factors
During the COVID-19 Pandemic: A
Mini-Review.
Front. Psychiatry 11:589614.
doi: 10.3389/fpsy.2020.589614

Suicide prevention in times of COVID-19 pandemic has become more challenging than ever due to unusual circumstances. The common risk factors identified with regard to suicidal behavior are fear of COVID-19, economic instability, poor access to healthcare facilities, pre-existing psychiatric disorders, and social disconnect. The studies done so far have reported either case studies or have made an effort to understand the risk factors. An understanding of the underlying causal pattern from existing theories, behind these risks, will enable adopting appropriate prevention mechanisms. Hence, this review examines evidence related to risk factors of suicides that occurred during COVID 19 and discusses it in the light of three major theoretical approaches: interpersonal model, stress diathesis model, and cognitive model. The insights obtained from the three viewpoints reveal that perceived burdensomeness, thwarted belongingness, stress sensitivity, cognitive errors such as magnification, catastrophic thinking, arbitrary inference, and mind-reading are likely reasons behind these risk factors for suicide. It is suggested that awareness regarding COVID-19 stressors, use of community-based approaches like gatekeeper training, and brief online psychotherapy by using techniques of mindfulness, interpersonal psychotherapy, and cognitive behavior therapy can be useful in reducing suicide risk during COVID-19.

Keywords: burdensomeness, thwarted belongingness, cognitive distortions, COVID-19, suicide, diathesis

INTRODUCTION

The novel coronavirus pandemic is an unimaginable life event that has impacted each and every individual in different ways. The direct effects of this disease are related to health but indirectly, the containment measures adopted to counter the contagious infection have created a plethora of socioeconomic and psychological repercussions (1, 2). People with psychiatric conditions, especially those who require institutionalized care and in-person psychotherapy sessions, have been adversely affected (3). In absence of proper medical care, individuals with psychiatric disorders may witness a change in activities of daily living, sleep-wake patterns, social rhythms, and heightened emotional reactions (4). Besides, indirectly this pandemic is a precipitating factor for people who have developed mood problems due to an overwhelming crisis. For example, Hawryluck et al. conducted a study during the SARS epidemic and demonstrated that the quarantine period could

be a triggering factor for psychological distress and a longer period of quarantine was associated with depression and post-traumatic stress disorder (5).

It has been observed that suicide rates generally increase after disasters. A higher rate of completed suicide was observed in victims of the 1999 Taiwan Earthquake (6). A study during the SARS outbreak in Taipei reported an increase in suicides after strict quarantine measures were imposed (7). Similar increasing trends in the number of suicides was seen in older adults who had a chronic illness or functional impairment during the SARS outbreak in Hong Kong in 2003 (8, 9). Suicide and self-harm behaviors have become pressing concerns during this COVID-19 pandemic as well. Some of the most potent risk factors for suicides identified by researchers during the COVID-19 pandemic are social isolation, economic downturn due to lockdown, increase in anxiety and stress in healthcare professionals (10), interpersonal violence (11), and stigma and discrimination (12). Thakur and Jain (2020) reported two suicidal cases from India, one because of wrongly interpreting the infection and the other one because of social isolation (10). An analysis of 72 suicide cases during the COVID-19 period in India reported that fear of getting infected with the virus was the most prominent reason for suicide incidence (13). These case studies and cross-sectional evidence give an idea about COVID-19 stressors and their relation to suicidal behavior. A recent systematic review on self-harm and suicide rates presented an analysis of modeling-based studies that estimated the effect of the pandemic on rise of suicidal cases which ranged from 1 to 145% (14).

However, the above-mentioned studies do not provide a clear understanding of the underlying causal patterns behind the emergence of risks. These risk factors have their origins in various cognitive errors, dysfunctional thinking patterns, traits vulnerability, and interpersonal attributes (15, 16). An understanding of these patterns can be important in giving direction to crisis intervention strategies to deal with suicidal behavior in such emergencies. Hence, the present review aims to discuss available literature that has identified the risk factors for suicides during COVID-19 and present them in the light of existing theoretical models. The findings from the relevant literature have been explained in the background of the interpersonal model of suicide, the stress diathesis model, and the cognitive model. Suicide risk factors have been explained by several theoretical viewpoints, but this review focuses on these three paradigms as they offer a broader understanding of the nature of risk factors related to suicides in this unprecedented pandemic. An implication from the theory helps in understanding the severity of risk factors and tracing the genesis of such a maladaptive pattern. In the review, we have used data from secondary sources and recent reported case studies, to highlight the increase in mood-related problems and subsequent increase in suicidal ideation and attempts. The paper also summarizes some of the psychological interventions that could help in dealing with suicide risk, some of which have been drawn from model-based approaches that have been used in this review.

EXPLANATION OF SUICIDE RISKS THROUGH THE INTERPERSONAL MODEL

The two major components of the interpersonal theory of suicide, i.e., thwarted belongingness and perceived burdensomeness have been attributed as reasons for suicidal behavior (17). Thwarted belongingness represents a psychological state in which the need for social connectedness and the need for belongingness are not adequately met (18). Social isolation, loneliness, and lack of social support are indicators that belongingness needs are unfulfilled. Many studies have linked loneliness as a risk factor for suicidal ideation and suicide attempts (19, 20). The current social exchange situation created by the COVID-19 pandemic requires the practice of social distancing, which may inadvertently lead to feelings of loneliness and isolation (21). Perceived burdensomeness is a state where an individual feels that he or she is a burden on others and that others will be better without his or her existence. Individuals with chronic illness, unemployment, and family discord can develop this sense of burdensomeness, which in turn can act as a trigger to suicidal behavior.

A recent study reported that the stay-at-home order, due to spread of COVID-19, was indirectly associated with suicide risk because of greater thwarted belongingness (22). The study explained that social disconnection and the absence of meaningful relationships were responsible for the association between stay-at-home orders and suicide risk. Research on older adults has also found that people of this age group are at higher suicide risk and may develop anxiety and depression due to this physical distancing, social disconnectedness, and perceived isolation (23). The risk factors identified in the studies can pose a threat to the belongingness needs of the individual and make them vulnerable to stress and suicide (see **Figure 1A**). A few reports claim that self-harm or suicidal tendencies in people of old age have increased, particularly in those who are dependent on their caregivers or family for their needs during this pandemic (24). A possibility of a perception of burdensomeness due to dependency and loss of productivity can reinforce such behaviors.

Studies based on rural-urban settings have highlighted that people living in rural areas are at increased suicidal risk as they experience more social isolation (11). The reason given for such an assumption is that generally, rural areas are less densely populated; hence, social support can be more difficult to obtain during acute suicidal crises. In such circumstances, the social disconnect can give rise to thwarted belongingness resulting in suicidal tendencies. Reports on attempted or completed suicides from media that have been cited in case studies have mentioned burden due to unemployment and job loss (25, 26); social boycott, discrimination, bereavement, and loss of loved ones (13) are also risk factors for suicidal behavior. These suicide factors can be traced through interpersonal theory constructs of burdensomeness and thwarted belongingness. A person who has lost a job recently or is unemployed might think that he is a burden on his family members. Social discrimination and feelings of stigma can be interpreted as signs of non-acceptance from societal members leading to a thwarted belongingness state.

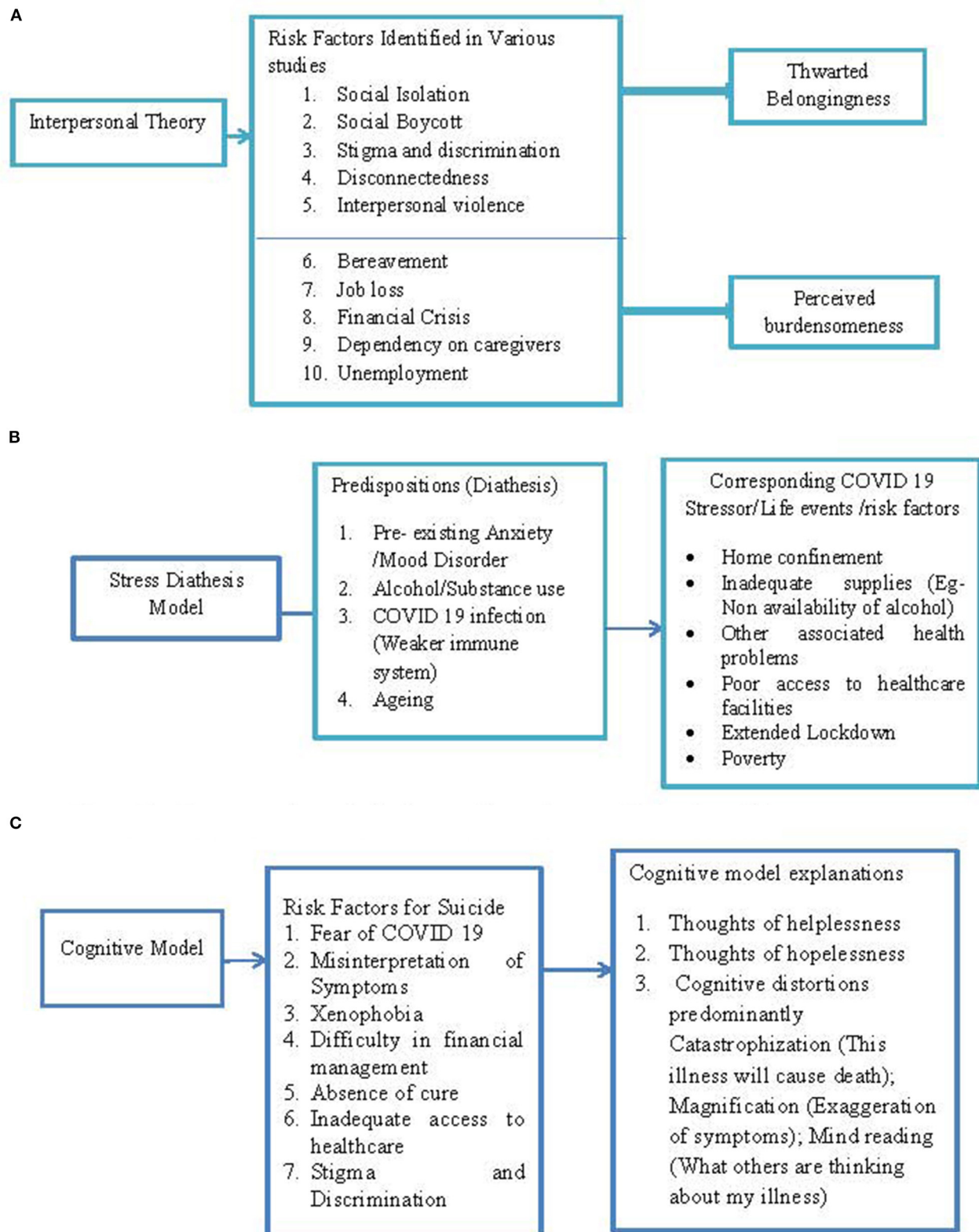


FIGURE 1 | (A) Representation of risk factors through interpersonal model. **(B)** Representation of risk factors through stress diathesis model. **(C)** Representation of risk factors through cognitive model.

Among other vulnerabilities traumatic experiences due to interpersonal violence, such as intimate partner violence, have shown an upward trend in COVID-19 (27). There have been instances of suicide cases due to these factors also. It has been speculated that substance use, economic volatility, and poverty have perpetuated reactions in men in the form of aggression against women (28). The trauma experienced by women due to interpersonal violence challenges the belongingness needs and is associated with dysphoric arousal and suicidal risk (29).

EXPLANATION OF SUICIDE RISKS THROUGH THE STRESS DIATHESIS MODEL

The stress diathesis model views suicide as a resultant action of a predisposition (diathesis) and an event (stressor) that triggers stress reactions in an individual and increase the susceptibility to attempt suicide (30). In general, the diathesis depends on certain traits in the psychological or clinical profile of the individual. Recent research has linked COVID-19 stressors such as self-isolation, being socially cut off, and economic uncertainties with higher traumatic stress in people with preexisting mood disorders (31). The study also mentions that people with anxiety-related disorders reported a greater level of distress due to fear of contamination, xenophobia, and perception of danger.

Stress-related disorders, sleep disorders, and mood disorders are strongly associated with suicidal behavior (32). A recent cross-sectional study from Colombia in the context of COVID-19 concluded that depressive symptoms due to confinement and insomnia are associated with higher perceived stress and higher suicide risk (33). Case studies based on newspaper reports have identified reasons where substance users committed suicide due to the non-availability of alcohol as shops were closed by abrupt lockdown (13). Thus, a preexisting psychiatric condition in combination with an active life event like COVID-19 and its related stressors further aggravates the stress and increases vulnerability to suicide. Instances from older adults committing suicide revealed that they had a preexisting medical condition and feared that they would be infected by COVID-19 (13). Age-related illnesses and chronic conditions such as diabetes and hypertension increase vulnerability (diathesis) and, when accompanied by fear of COVID-19 (stressor), lead to distress and suicidal behavior.

Survivors of COVID-19 infections are also at an increased risk for suicide (34). A recent study has shown that about 25% of COVID-19 patients experience neurological problems, too (35). It has been observed that COVID-19 patients are reporting dizziness, headache, seizures, ischemic stroke, and other neurological problems (34, 36). The idea of COVID survivors' increased risk for suicide is supported by the findings of a previous study, which reports that neurological disorders such as ischemic stroke and headaches are associated with increased propensity to suicide (37). This evidence points to links between COVID-19 infection leading to other neurological problems and suggests that it might be the cause of stress reactions. On the other hand, other evidence has speculated that COVID-19 causes

mood symptoms. It has been hypothesized that immune system responses to SARS CoV-2 may induce mood symptoms and suicidal ideation in some subpopulations (38). These speculated links to suicide provide an alternate explanation whereby the weakened neurological and immunological response aggravates susceptibility to stressors and induces mood conditions and suicidal tendencies (see **Figure 1B**).

EXPLANATION OF SUICIDE RISK THROUGH THE COGNITIVE MODEL

The cognitive approach has provided compelling evidence about the development of depressive cognition and suicide. The nature of COVID-19 is such that its related stressors are uncontrollable, which can make individuals apprehensive and helpless. Lack of a cure, poor access to medical facilities, and uncertainties regarding the end of pandemic can prompt feelings of hopelessness. These feelings are backed by automatic negative thoughts, which could be a possible explanation for cases of suicide reported due to financial instability, employment status, postponement of exams, and inadequate supplies during lockdown (26, 39). Additionally, several cognitive distortions can perpetrate negative thinking patterns and form the basis of suicidal thoughts/behavior (15). The case studies dealing with suicide attempts due to circumstances involving COVID-19 provide the impression that dysfunctional thought patterns could be a possible cause of negative emotions and suicidal attempts. There are cases where people thought they were COVID-19 positive and experiencing symptoms of the disease, because of a misinterpretation of their flu symptoms/illnesses (13, 39, 40). These misinterpretations can be understood in the context of "magnification" and "arbitrary inference" cognitive distortions. The symptoms of one illness that are similar to those of COVID-19 can lead to the tendency to overgeneralize, and people may possibly overlook other evidence. These distortions might lead to negative thoughts related to dying (see **Figure 1C**).

Another prominent cognitive distortion for suicidal behavior seems to be "catastrophic thinking." Suicide attempts due to fear of contracting COVID-19, postponement of exams, and being COVID-19-positive could be related to this cognitive distortion. Sahoo et al. reported two cases, the first of which was of a person who shot himself while he was in self-isolation. He developed mood symptoms after coming in contact with a COVID-19-positive person and isolated himself. As per the report he was preoccupied by thoughts of dying from COVID-19 and therefore committed suicide (41). The same study reported an attempted suicide by an individual who was asked to take a photograph of a foreign couple, while he was on his morning walk. Later, he was in panic when he came to know about the transmission mode, death rates, and links to foreign travel via media and news channels. He was in a state of social withdrawal and assumed that he was going to die and therefore attempted suicide (41). These individuals imagined the worst outcomes demonstrating catastrophic thinking.

Suicidal deaths due to the stigma related to COVID-19, xenophobia, and social discrimination can be understood

through the lens of the “mind reading” cognitive distortion. This distortion is described as a tendency to overemphasize and misjudge others’ perception of them. In two such noticeable cases, it was found that the reason for suicide was the perception of discrimination and xenophobia. These individuals worked in a different place, and due to lockdown they returned to their villages. They believed that the villagers were thinking about them negatively and discriminating against them, and so they committed suicide (32, 42).

DISCUSSION AND RECOMMENDATIONS

This review is an attempt to establish the theoretical links behind risk factors for suicides during COVID-19. The risk factors identified have been discussed in consideration of three major theoretical models, i.e., the interpersonal model, the stress diathesis model, and the cognitive model. Interestingly, all the models offer an elaborative explanation of the risk factors such as isolation, age-related suicide, preexisting mood disorders, chronic illness, poverty, unemployment, and fear of COVID-19. A recent study in the context of COVID-19 determining youth’s susceptibility for high risk for psychosis emphasizes stress sensitivity, diathesis-stress model, and cognitive biases as the potential factors (43). Thwarted belongingness and perceived burdensomeness have been previously linked to suicide risk during the Red River flood disaster (44). Dysfunctional thought patterns and cognitive errors of catastrophic thinking, magnification, arbitrary inference, and mind-reading have been reported in cases of suicide after stressful life events (15, 45). The insights generated through the explanations in this integrated model can be very useful in chalking out crisis interventions during such emergencies.

Suicidal behavior in itself is an emergency condition that needs efficient crisis intervention strategies. Many countries have responded to this crisis by setting up psychosocial support and suicide helplines to respond to an immediate crisis. Apart from these support systems, efforts are being made to raise awareness regarding the symptoms of COVID-19 and take care of mental health (3). However, the consequences of COVID-19 stressors are appalling and highly uncertain. Special populations, such as older adults, people with preexisting psychiatric illness, and people with mood symptoms, may need further support. The current pandemic poses an additional challenge to the practice of psychological interventions through in-person settings. Hence, digital modalities such as web-based counseling, telepsychotherapy, and teleconsultations can be used as alternatives. Although web-based modalities are not free from limitations, such as the absence of non-verbal cues, problems related to inhibition, and temporal fluidity (46). But in times of physical distancing, they can be used to address crisis-related issues. Healthcare professionals, especially psychologists and social workers, can train caregivers, nurses, and staff, as well as family members, to learn and practice suicide assessment and brief interventions online (47, 48).

The gatekeeper training approach can be very useful in identifying people at risk for suicide (49). The training involves

teaching a certain group of people to identify, assess, and refer people who are at increased suicide risk. These people can be primary contacts of individuals such as family members, friends, school teachers, or college instructors who can act as gatekeepers to help suicidal people. The training is being given as an online course, too, and can be an efficient method to extend help to such individuals (50). These trained individuals will act as a bridge between people at suicide risk and mental health professionals who can help.

Older adults who are not very familiar with the use of technology-based interfaces for communication might experience social cut off and loneliness. Therefore, training the caregivers using short counseling videos on taking care of the elderly who are at risk and enabling them to tackle feelings of loneliness might be helpful. Brief online interventions for interpersonal therapy where the caregivers can be trained to address low levels of belongingness can be used (51). Techniques such as activity scheduling, cognitive exercises, and other behavior therapy techniques based on reinforcement, home-based tasks can be implemented by caregivers and family members so that older adults can engage themselves in constructive activities (52, 53). These activities can lessen feelings of burdensomeness and encourage productivity. Virtual social support via social media can compensate for feelings of isolation and challenges of belongingness (54).

Mindfulness-based therapies, especially mindfulness meditation techniques, mindfulness-based stress reduction strategies through videos and audios, and mindfulness-based cognitive therapy techniques, can address stress related to burnout, compassion fatigue, sleep problems, negative thoughts, and overwhelming emotions in healthcare professionals and frontline workers. Brief protocols of the above-mentioned techniques can be practiced in workplaces and hospitals as a routine practice. Several studies have demonstrated the efficacy of mindfulness-based cognitive therapy techniques in reducing depressive cognition and suicidal cognition (55–57). Brief cognitive therapy sessions through videoconferencing can be done, and the client can be assigned tasks and worksheets that they can return via email/texts (58).

The COVID-19 pandemic is a crisis that is going to last for a while. As countries are struggling to deal with the consequences of the pandemic, the rise in psychiatric disorders and suicidal behaviors is alarming. However, with the right approaches, such as spreading awareness, strengthening telepsychotherapy, teleconsultations, and promoting self-help strategies, the frequency of suicide risk can be reduced.

AUTHOR CONTRIBUTIONS

SR, DG, and TS conceptualized the research topic. SR and DG prepared the initial draft. TS, SV, and YA reviewed the initial draft and suggested changes. SR, DG, TS, SV, and YA contributed to the preparation of the final manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Factors Associated With Psychological Distress in Health-Care Workers During an Infectious Disease Outbreak: A Rapid Systematic Review of the Evidence

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OPEN ACCESS

Edited by:

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Reviewed by:

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 30 July 2020

Accepted: 15 December 2020

Published: 28 January 2021

Citation:

Sirois FM and Owens J (2021) Factors Associated With Psychological Distress in Health-Care Workers During an Infectious Disease Outbreak: A Rapid Systematic Review of the Evidence. *Front. Psychiatry* 11:589545. doi: 10.3389/fpsy.2020.589545

Objective: Health-care workers (HCW) are at risk for psychological distress during an infectious disease outbreak, such as the coronavirus pandemic, due to the demands of dealing with a public health emergency. This rapid systematic review examined the factors associated with psychological distress among HCW during an outbreak.

Method: We systematically reviewed literature on the factors associated with psychological distress (demographic characteristics, occupational, social, psychological, and infection-related factors) in HCW during an outbreak (COVID-19, SARS, MERS, H1N1, H7N9, and Ebola). Four electronic databases were searched (2000 to 15 November 2020) for relevant peer-reviewed research according to a pre-registered protocol. A narrative synthesis was conducted to identify fixed, modifiable, and infection-related factors linked to distress and psychiatric morbidity.

Results: From the 4,621 records identified, 138 with data from 143,246 HCW in 139 studies were included. All but two studies were cross-sectional. The majority of the studies were conducted during COVID-19 ($k = 107$, $N = 34,334$) and SARS ($k = 21$, $N = 18,096$). Consistent evidence indicated that being female, a nurse, experiencing stigma, maladaptive coping, having contact or risk of contact with infected patients, and experiencing quarantine, were risk factors for psychological distress among HCW. Personal and organizational social support, perceiving control, positive work attitudes, sufficient information about the outbreak and proper protection, training, and resources, were associated with less psychological distress.

Conclusions: This review highlights the key factors to identify HCW who are most at risk for psychological distress during an outbreak and modifying factors to reduce distress and improve resilience. Recommendations are that HCW at risk for increased distress receive early interventions and ongoing monitoring because there is evidence that HCW distress can persist for up to 3 years after an outbreak. Further research needs to track the associations of risk and resilience factors with distress over time and the extent to which certain factors are inter-related and contribute to sustained or transient distress.

Keywords: COVID-19, health-care workers, psychological distress, risk factors, resilience, anxiety, stress, depression

INTRODUCTION

Several outbreaks of viral diseases have posed significant public health threats since 2000. These include SARS, H1N1, H7N9, MERS, EBOLA, and more recently, COVID-19 (see **Supplementary Table 1**). Such outbreaks place a serious strain on the health-care systems that try to contain and manage them, including health-care workers (HCW) who are at increased risk for nosocomial infections (1). In addition to the threat to their own physical health, HCW can experience psychological distress as a collateral cost of the risk of infection and the demands of dealing with a public health emergency (2).

Psychological distress refers to a state of emotional suffering, resulting from being exposed to a stressful event that poses a threat to one's physical or mental health (3). Inability to cope effectively with the stressor results in psychological distress that can manifest as a range of adverse mental health and psychiatric outcomes including depression, anxiety, acute stress, post-traumatic stress, burnout, and psychiatric morbidity. Although psychological distress is often viewed as a transient state that negatively impacts day-to-day and social functioning, it can persist and have longer-term negative effects on mental health (4).

Under normal circumstances, work-related psychological distress in HCW is associated with several short and long-term adverse outcomes. Psychological distress is linked to adverse occupational outcomes including decreased quality of patient care (5), irritability with colleagues (6), cognitive impairments that negatively impact patient care (7), and intentions to leave one's job (8). HCW who experience psychological distress are also at risk of experiencing adverse personal outcomes including substance misuse (6), and suicide (9). In the context of an infectious disease outbreak, such consequences may amplify and heighten psychological distress. HCW who reported elevated levels of psychological distress during the COVID-19 outbreak also experienced sleep disturbances (10), poorer physical health (11), and a greater number of physical symptoms, including headaches (12). Similarly, HCW during the SARS outbreak disclosed a greater number of somatic symptoms and sleep problems (13), substance misuse and more days off work (14).

Apart from the immediate and short-term impacts on HCW mental health, there is limited but concerning evidence, that working during an infectious outbreak can have lasting and detrimental psychological effects for HCW. In a study of HCW who worked during the SARS outbreak in China, 10 percent experienced high levels of post-traumatic stress (PTS) symptoms when surveyed 3 years later (15). Similarly, HCW who treated patients during the SARS outbreak in Canada reported significantly higher levels of burnout, psychological distress, and post-traumatic stress compared to HCW in other hospitals that did not treat SARS patients when surveyed 13–26 months after the SARS outbreak (14). Lastly, a study of HCW in Hong Kong during the SARS outbreak found that although the levels of perceived stress did not differ between

HCW who worked in high risk and low risk areas initially, 1 year later the stress of the high-risk HCW was significantly increased, and was higher than the stress reported by the low-risk HCW (16). This increased level of stress was also associated with higher levels of depression, anxiety, and post-traumatic stress, indicating a pervasive and sustained negative impact of working during an outbreak on mental health. These findings underscore the importance of understanding the factors that contribute to risk and resilience for psychological distress in HCW.

HCW serve a vital role in treating and managing infected individuals during an infectious disease outbreak such as coronavirus. There is an urgent need to understand the factors that create or heighten risk for distress for HCW and affect their immediate and long-term mental health during the COVID-19 pandemic and other similar outbreaks, as well as those that are protective and may reduce psychological distress. Such knowledge is important for identifying HCW most at risk, and informing strategies and treatments needed to support HCW resilience during and after an outbreak.

This rapid review synthesized the evidence on the factors associated with psychological distress among health-care workers (HCW) during an infectious disease outbreak. The review focused not only on the COVID-19 pandemic, but also on other related coronavirus and influenza outbreaks (SARS, H1N1, H7N9, MERS, and Ebola), to expand the potential evidence base and to increase the potential for the findings to be generalizable across any future infectious disease outbreaks.

This review also introduced a conceptual framework for understanding and classifying the factors that contributed to risk or provided resilience for psychological distress. Based on our early scan of the literature, we grouped factors into three conceptual categories: (1) fixed or unchangeable factors, (2) potentially modifiable factors, and (3) factors related to infection exposure. Fixed factors were viewed as identifying HCW who might be most vulnerable or resilient to distress and, if the former, require extra support and treatment. Socio-demographic factors and other factors related to work role and experience were included in this category. In contrast, modifiable factors were viewed as identifying potential targets for interventions to reduce risk and increase resilience. Social and psychological factors, such as social support, stigma, and psychological resources such as coping styles and personality were included in the modifiable category. Lastly, infection-related factors were those that can directly inform hospital procedures and operating policy regarding ways to address and mitigate risk. Factors related to infection exposure and risk of exposure, and the provision of training, resources, and personal protective equipment (PPE) were included in this category.

The key questions addressed by this review were:

- 1) What are the risk factors for psychological distress among HCW during an infectious outbreak?
- 2) What are the factors associated with reduced risk for psychological distress among HCW during an infectious outbreak?

METHODS

Evidence was summarized using a rapid, systematic review approach because of the urgent need to support the mental health of HCW during and after the ongoing novel coronavirus pandemic. Rapid Reviews are a form of systematic review that provide an expedient and useful means of synthesizing the available evidence during times of health crises to inform evidence-based decision making for health policy and practice (17, 18). To accomplish this, rapid reviews take a streamlined approach to systematically reviewing evidence. Modified methods in the current review included: (1) search limited to English language studies; (2) gray literature limited to one search source; (3) no formal critical appraisal of the research.

Data Sources and Searches

The search strategy for this pre-registered rapid review involved searching Medline, PsycInfo, Web of Science, and the first 10 pages of Google Scholar, as well as hand searching references. Search terms included a combination of terms related to health-care workers (e.g., “physicians,” “nurses”), and distress (e.g., “stress,” “anxiety”). The full search term list is available on PROSPERO (CRD42020178185). We conducted searches in a rolling manner, starting on April 6, 2020, then with updates on June 7, July 2, July 10, July 30, 2020, and November 15, 2020 to capture and integrate the most up-to-date evidence given the ongoing COVID-19 pandemic and the associated rapid release of research.

Study Selection and Data Extraction

We used a predefined search strategy (see full details on PROSPERO, <https://www.crd.york.ac.uk/PROSPERO/>; registration ID: CRD42020178185). Studies were included in this Review if they were empirical research; published or accepted for publication in peer-reviewed journals; written in English; included participants who were HCW who worked in a hospital environment during a major infectious outbreak (COVID19, SARS, MERS, H1N1, H7N9, Ebola); had a sample size of >80, and included data on factors associated with psychological distress during an outbreak. One investigator screened citations for potential full-text review, and a second investigator conducted the full-text review of each study for inclusion. Exclusions were verified by the other investigator, and disagreements resolved through discussion. Data was extracted by one investigator, entered into a table, and verified by a second investigator. For studies that included tests for multiple measures of psychological distress, we included the study as reporting a significant association with a particular factor if at least one of the measures of distress were significant.

Although rapid reviews do not always include a formal assessment of study quality and risk for bias (18), a lack of a quality assessment can have important implications for the utility of the results (17). Accordingly, we evaluated the methodological quality of the studies in the review using a tool adapted for the current study. The assessment tool included eleven questions chosen from the Appraisal tool for Cross Sectional Studies, AXIS

(19) as being most relevant for the current study, an approach advocated by Quintana (20). Two authors independently rated the quality of the studies using the 11 questions to assess the quality of the study procedures, sampling, and the measures. The assessment yielded a total score that categorized studies as having low (<5), moderate (5–7), or high (8–10) quality. Inter-rater agreement was calculated and assessed using Cohen’s Kappa coefficient (21). Discrepancies were resolved through discussion. In addition to the formal quality assessment, we only included studies that reported findings for a sample size of >80, which allows enough power to detect a medium effect size with an alpha of 0.05 (21, 22).

Data Synthesis and Analysis

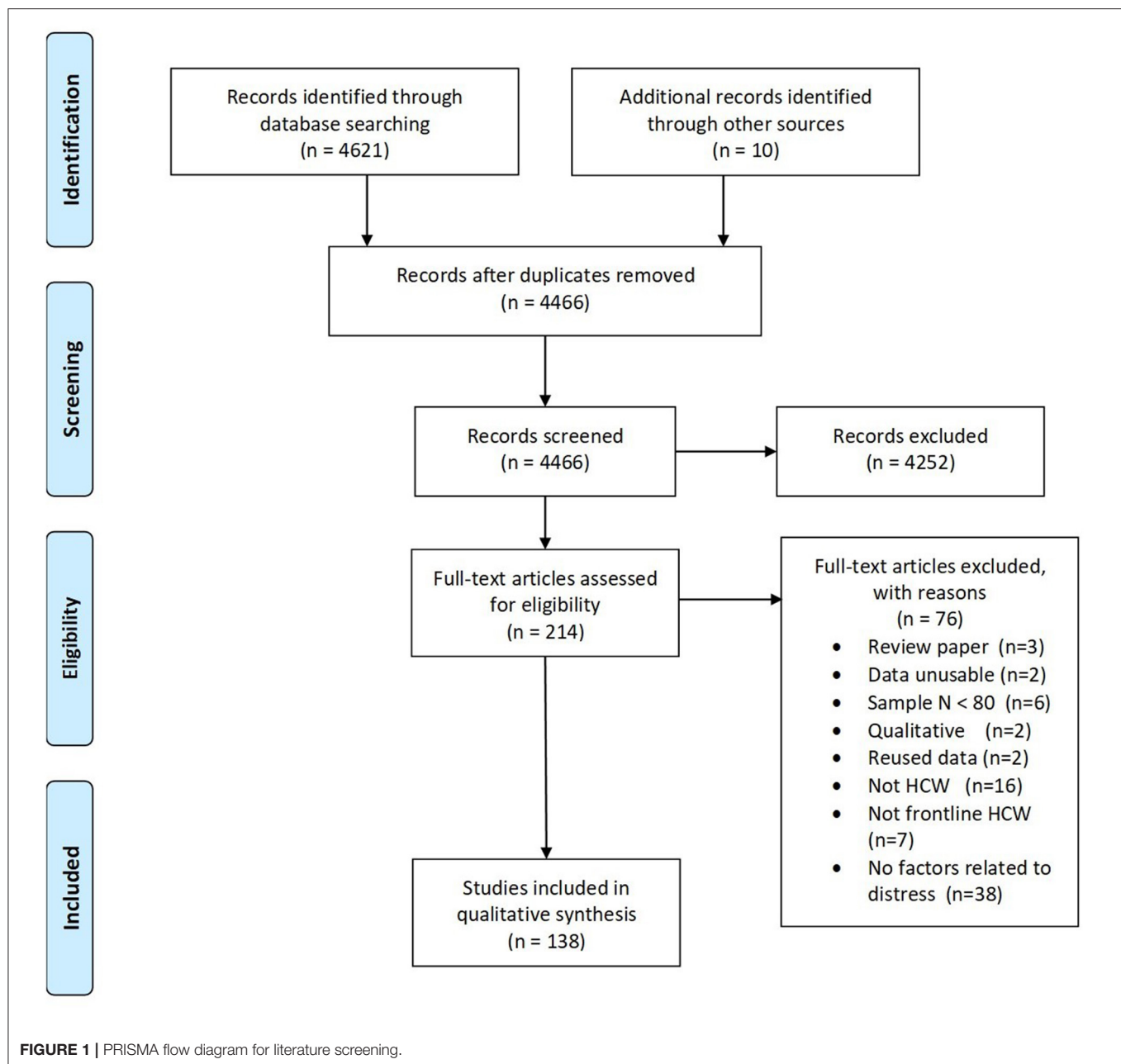
We conceptually organized the factors in this Review identified as contributing to or mitigating psychological distress into three broad categories: (1) fixed or unchangeable factors (sociodemographic and occupational factors), (2) potentially modifiable factors (social and psychological factors), and (3) factors related to infection exposure. Evidence was synthesized according to these conceptual categories, with non-significant and contrary findings noted in addition to significant findings to provide a more complete picture of the weight of the evidence for each factor. The balance of evidence for each factor was further presented graphically. We assigned factors within each conceptual category as reflecting either risk or resilience for psychological distress according to logic and theory (e.g., maladaptive coping as risk, adaptive coping as resilience). Factors that could be interpreted as either risk or resilience (e.g., sex, age) were assigned according to how they had been framed in the majority of the research that examined these factors.

RESULTS

The search yielded 4621 records, with 138 papers reporting 139 studies (Total $N = 143,246$ HCW) that met inclusion criteria for this Review. **Figure 1** presents the complete screening process. Characteristics of the studies are in **Table 1**. The average sample size was 1,030 (range 82–21,199). The studies included HCW working across 34 countries during COVID-19 ($k = 107$, $N = 120,711$), SARS ($k = 21$, $N = 18,096$), MERS ($k = 7$, $N = 1,567$), H1N1 ($k = 2$, $N = 2,094$), Ebola ($k = 1$, $N = 143$), and H7N9 ($k = 1$, $N = 102$), outbreaks. The rates of psychological distress in HCW varied depending on how distress was measured (**Table 1**). **Figures 2, 3** provide a graphical overview of the weight of the evidence per factor.

Methodological Quality

The quality of the studies ranged from moderate to high, with no studies rated as having low quality. The majority of the 139 studies were rated as having high quality (118; 84.9%), and 21 studies were rated as having a moderate quality (15.1%). Inter-rater agreement was high, 90.65% agreement, Cohen’s Kappa = 0.642 (see **Supplementary Table 2**).



Sociodemographic Factors

Seventy-two studies examined age as a predictor of psychological distress among HCW during an epidemic (see **Table 2**). Of these, 39 found that age was a significant risk factor for distress. In two studies of HCW during the SARS outbreak, staff who were younger than 33 experienced greater stress, but not greater psychiatric morbidity, compared to older staff (134), and staff under 35 were more likely to report severe depressive symptoms 3 years after the outbreak (92). In another study, medical staff who were between 20 and 30 years old and exposed to patients with H7N9 had elevated post-traumatic stress disorder scores compared to older staff (157). Similarly, general practitioners in

working during the SARS outbreak who met psychiatric caseness for PTSD were more likely to be younger (144). In a study during the H1N1 outbreak, hospital staff who were in their 20's had greater anxiety about becoming infected than did older staff (103). During COVID-19, HCW who were younger were more likely to experience higher levels of post-traumatic stress symptoms, depression, anxiety, and acute stress compared to older HCW (23, 26–28, 30, 32, 42, 49, 54, 55, 57, 61, 65, 71, 75, 78, 89, 90, 117, 118, 121, 123, 127, 131, 149, 153, 154). In contrast, eight studies conducted during COVID found that HCW who were older were at greater risk of experiencing higher levels of psychological distress (40, 66, 86, 95, 102, 114, 122, 132).

Lastly, 33 studies found that age was not a significant predictor of distress in HCW during the SARS, MERS or during the COVID-19 outbreaks (Table 2).

Ninety studies tested sex as a possible risk factor for distress among HCW during an outbreak (Table 2), with all but 33 finding that being female was associated with higher risk for psychological distress. Notably, the 57 studies that found that female sex was a significant risk factor spanned six different infectious diseases (MERS, SARS, COVID-19, H1N1, H7N9, and SARS), suggesting that being a female HCW increases vulnerability for distress more generally when working during an infectious outbreak. Notably, among the studies 30 studies that did not find that being female created significant risk for distress, eleven (36.6%) were conducted with nurses and included predominantly female participants (24, 43, 44, 59, 70, 79, 80, 89, 108, 140, 153).

Of the 69 studies that examined marital status as a risk or resilience factor for psychological distress, 19 found evidence to suggest this as a risk factor (Table 2). For example, two studies of HCW during the SARS outbreak found that HCW who were single were 1.4 times more likely to experience psychological distress than married HCW (41), and more likely to have severe depressive symptoms 3 years later (92). Similarly, HCW during the COVID-19 outbreak who were single experienced higher levels of distress than those who were married (54, 57, 66, 69, 111, 122, 126). Conversely, four studies conducted during COVID-19 found that being married was a risk factor for greater distress (66, 75, 89, 94), and two studies found that married HCW with children reported greater stress than single HCW or those who were married without children (72, 83). Forty-seven other studies conducted during the SARS, MERS, and COVID-19 outbreaks found no associations between HCW marital status and distress (Table 2).

Thirty-three studies examined education levels in association with distress. Only eight studies, six conducted during the COVID-19 pandemic (27, 66, 70, 89, 94, 149, 151), along with studies conducted during the Ebola outbreak (76), and the MERS outbreak (81) found that HCW with higher educational levels reported significantly lower psychological distress. Twenty-two studies found that education level was not predictive of psychological distress among HCW working during the MERS or the COVID-19 outbreaks (Table 2).

Occupational Factors

Thirty-four studies examined and found evidence that the HCW occupational role created risk for psychological distress while working during the SARS, H1N1, MERS, and COVID-19 outbreaks (Table 2). In all but 16 studies, being a nurse was associated with a range of mental health issues, including higher stress, burnout, anxiety, depression, PTSD symptoms, psychiatric morbidity, and psychological distress compared to being a physician or other HCW (see Tables 1, 2). The extent to which nurses experienced greater psychological distress whilst working during an outbreak was estimated in several studies. For example, nurses were 1.2 (83), 1.4 (124), 2.2 (63), and 2.8 (107) times more likely to be at risk for poor mental health. In contrast, five studies found that physicians (13, 97, 119, 128) and technicians

(41) were more likely to experience distress while working during the COVID-19 pandemic and the SARS outbreak. Sixteen studies conducted during the COVID-19 outbreak did not find that occupational role was a risk factor for distress (Table 2).

Other occupational factors examined included years of work experience, and full-time vs. part-time status. Twelve of the 35 studies found evidence to suggest that less work experience may create risk (Table 2). HCW who had worked for <2 years experienced significantly greater stress than those with more work experience in a large sample of HCW during the SARS pandemic (13). In HCW during the SARS outbreak, those with <10 years of experience reported higher levels of psychological distress, but not burnout or post-traumatic stress, 13–26 months after the outbreak (14). HCW who had less clinical experience were also more likely to experience stress during the COVID-19 outbreak (23, 28, 55, 65, 69, 154). Years of clinical experience was not associated with PTSD symptoms, acute stress or anxiety, depression, mental health status, or burnout in 21 other studies (Table 2). Two studies found that less work experience was protective against distress for HCW during COVID-19 (121, 122). Lastly, in one study, part-time worker status was a significant predictor of greater emotional distress in HCW during the SARS outbreak (107), whereas another study found no evidence of part-time work status creating risk for distress in HCW during COVID-19 (119).

Social Factors

A number of social and interpersonal factors mitigated or contributed to psychological distress. Receiving direct social support from friends, family, colleagues and supervisors was a key protective factor in all of the 19 studies that examined its association with psychological distress (Table 2). For example, in HCW during the COVID-19 outbreak, higher levels of social support were associated with significantly lower levels of stress, depression, anxiety, depression and PTSD (28, 31, 38, 62, 70, 78, 88, 90, 94, 102, 139, 156). These findings were consistent with that of a study of frontline medical staff during the COVID-19 outbreak who reported that a positive attitude from co-workers was important for reducing their distress (39). Analogously, emergency nurses working during MERS outbreak who reported poor support from family and friends experienced higher levels of burnout (81). Similarly, studies of HCW during the SARS outbreak found that higher levels of family support were associated with lower depression and anxiety whereas inadequate support from relatives, lack of gratitude from patients and relatives, and perceiving less of a team spirit at work was associated with higher levels of psychological distress (44, 134).

Organizational support was an important factor in buffering psychological distress of HCW during an outbreak in all 11 studies that examined this factor. In nurses working during the SARS outbreak in Canada, higher perceived organizational support in the form of receiving positive performance feedback from doctors and co-workers, was associated with lower perceptions of SARS-related threat and reduced feelings of emotional exhaustion (59). Similarly, nurses, physicians, and HCW working during the MERS, COVID-19, and SARS

TABLE 1 | Characteristics of the 139 studies ($N = 143,246$) included in the rapid review.

Study authors and year	Country	Study design	Sample (% female)	Infectious disease	Study period	Psychological distress measures	Rates of distress (%)	Risk/resilience factors tested
Abdulah and Mohammed (23)	Kurdistan	Cross-sectional	209 doctors (25.4)	COVID-19	09/04/2020–14/04/2020	PSS-10 to measure stress	21.1 (Low stress) 69.4 (Moderate stress) 9.6 (high stress)	Age, sex, work experience
Ahmed et al. (24)	China	Cross-sectional	497 nurses (78.87)	COVID-19	18/01/2020–20/01/2020	K-6 to measure non-specific psychological distress	65.0 (moderate to severe psychological distress)	Social support-professional/organizational
Aksoy and Koçak (25)	Turkey	Cross-sectional	758 nurses and midwives (92.70)	COVID-19	1/04/2020–14/04/2020	STAI to measure anxiety	NR	Sex, exposure to confirmed infected cases.
Al Mahyijari et al. (26)	Oman	Cross-sectional	150 doctors and nurses (77.30)	COVID-19	NR	PSS-10 to measure stress, GAD-7 to measure anxiety	30.0 (moderate to severe anxiety)	Sex, age, HCW type
Alan et al. (27)	Turkey	Cross-sectional	416 HCW (79.10)	COVID-19	16/04/2020–20/04/2020	DASS to measure depressive symptoms, anxiety and stress	17.8 (moderate depression) 16.8 (severe depression) 18.1 (extremely severe depression) 17.8 (moderate anxiety) 13.9 (severe anxiety) 22.6 (extremely severe anxiety) 19.7 (moderate stress)	Age, sex, marital status, HCW type, higher education level, direct contact with confirmed infected cases
Arafa et al. (28)	Egypt and Saudi Arabia	Cross-sectional	426 doctors, nurses and HCW-ancillary workers (49.8)	COVID-19	14/04/2020–24/04/2020	DASS-21 to measure stress, depressive symptoms and anxiety	69.0 (depression) 59.8 (anxiety) 55.9 (stress)	Sex, age, social support-personal, social support-professional/organizational
Arshad and Islam (29)	Pakistan	Cross-sectional	431 doctors (44.78)	COVID-19	Last week of March 2020	GAD-7 to measure anxiety	27.84 (mild anxiety) 23.90 (moderate anxiety) 9.74 (severe anxiety)	Age, Sex
Azoulay et al. (30)	85 countries (European Society of Intensive Medicine)	Cross-sectional	1,001 HCW (34.20)	COVID-19	30/04/2020–25/5/2020	HADS to measure anxiety and depressive symptoms, MBI to measure burnout	46.5 (anxiety) 30.2 (depression)	Age, sex, marital status single vs. married
Babore et al. (31)	Italy	Cross-sectional	595 HCW (80.3)	COVID-19	11/04/2020–16/04/2020	PSS-10 to measure stress	NR	Sex, marital status; married with children, social support-personal, direct contact with infected cases, adaptive and maladaptive coping style, positive work attitudes

(Continued)

TABLE 1 | Continued

Study authors and year	Country	Study design	Sample (% female)	Infectious disease	Study period	Psychological distress measures	Rates of distress (%)	Risk/resilience factors tested
Badahdah et al. (32)	Oman	Cross-sectional	509 doctors and nurses (80.30)	COVID-19	1st 2 weeks of April 2020	GAD-7 to measure anxiety, PSS-10 to measure stress	25.9 (moderate to severe anxiety) 56.4 (high stress)	Age, sex, marital status, HCW type, exposure to confirmed infected cases
Barello et al. (33)	Italy	Cross-sectional	376 doctors and nurses (73.70)	COVID-19	5 weeks from the beginning of COVID-19 epidemic in Italy	MBI to measure burnout	37.0 (high emotional exhaustion)	Sex, HCW type
Bates et al. (34)	UK England	Cross-sectional	117 doctors, nurses and allied health professionals (77.00)	COVID-19	3/04/2020–18/04/2020	GAD-7 to measure anxiety, PCL-5 to measure post-traumatic stress disorder	33.0 (anxiety) 17.0 (distress: PTSD)	HCW type
Bettinsoli et al. (35)	Italy	Cross-sectional	580 doctors, nurses and allied health professionals (40.00)	COVID-19	26/03/2020–9/04/2020 Middle of outbreak in Italy	GHQ-12 to measure psychological distress	33.5 (psychological distress)	Sex, HCW type, marital status: married with children, direct contact with infected cases, perceived control, adaptive coping style
Blekas et al. (36)	Greece	Cross-sectional	270 HCW (73.7)	COVID-19	10/04/2020–13/04/2020	PDI to measure levels of distress, PHQ-9 to measure depressive symptoms, PTSD-8 to measure post-traumatic stress disorder	16.7 (distress PTSD)	Age, sex
Bukhari et al. (37)	Saudi Arabia	Cross-sectional	386 HCW (86.00)	MERS	NR	Study specific measure of worry about contracting MERS	33.2 (extremely or very worried)	Sex, direct contact with confirmed infected cases
Cai et al. (38)	China	Cross-sectional	1,521 HCW (75.54)	COVID-19	NR	SCL-90-R to measure psychological distress	14.1 (psychological distress)	Age, sex, marital status: married with children, HCW type, Social support-personal, less work experience, adaptive personality traits
Cai et al. (39)	China	Cross-sectional	534 HCW (68.70)	COVID-19	01/2020–03/2020	Study specific measure of stress	NR	Social support-personal
Caillet et al. (40)	France	Cross-sectional	208 HCW in the ICU (75.00)	COVID-19	8/04/2020–21/04/2020 Peak of the pandemic	HADS to measure anxiety and depressive symptoms, IES-R to measure post-traumatic stress disorder	48.0 (anxiety) 16.0 (depression) 27.0 (distress; PTSD)	Sex, age, HCW type, risk of exposure to confirmed cases
Chan and Huak (41)	Singapore	Cross-sectional	661 doctors and nurses (NR)	SARS	05/2003 2 months after SARS outbreak	IES-R, to measure post-traumatic stress disorder, GHQ-28 to measure distress	27.0 (distress; PTSD)	HCW type, marital status, social support-personal, adequate information, positive work attitude

(Continued)

TABLE 1 | Continued

Study authors and year	Country	Study design	Sample (% female)	Infectious disease	Study period	Psychological distress measures	Rates of distress (%)	Risk/resilience factors tested
Chatterjee et al. (42)	India-West Bengal	Cross-sectional	152 doctors (21.70)	COVID-19	28/03/2020–06/04/2020	DASS-21 to measure depressive symptoms, stress and anxiety	34.9 (depression) 39.5 (anxiety) 32.9 (stress)	Age, sex, less work experience, at risk of being in contact with infected patients
Chen et al. (43)	Taiwan	Cross-sectional	128 nurses (100.00)	SARS	During mid-May 2003, at the peak of the SARS outbreak.	IES to measure PTSD, SCL-90-R to measure psychological distress	11.0 (distress: PTSD)	At risk of being in contact with infected patients
Chen et al. (44)	Taiwan	Prospective	116 nurses (98.30)	SARS	May 2003	SAS to measure anxiety, SDS to measure depressive symptoms	NR	Social support-personal, training for dealing with SARS provided
Chen et al. (45)	China	Cross-sectional	902 HCW (68.63)	COVID-19	9/02/2020–11/02/2020 Peak of pandemic	CMBI to measure post-traumatic stress disorder, GAD-7 to measure anxiety, PHQ-9 to measure depressive symptoms	24.5 (moderate-severe anxiety and depression) 16.63 (moderate to severe anxiety) 18.29 (moderate to severe depression)	Sex, HCW type, adaptive and maladaptive coping style, adaptive personality traits
Chen et al. (46)	China and Taiwan	Cross-sectional	12,956 nurses (95.60)	COVID-19	April 2020	MBI GS to measure extent of emotional exhaustion,	24.7 and 23.5 (emotional exhaustion HRW)	Sex, exposure to confirmed infected cases
Chen et al. (47)	China	Cross-sectional	171 HCW (67.83) (94 HRW [74.50], 77 LRW [59.70])	COVID-19	NR	PCL-C to measure post-traumatic stress disorder, GAD-7 to measure anxiety, PHQ-9 to measure depressive symptoms	28.7 (distress; PTSD:HRW) 13.0 (distress; PTSD:LRW) 63.8 (anxiety: HRW) 45.5 (anxiety: LRW) 19.1 (moderate to severe depression: HRW) 6.5 (moderate to severe depression LRW)	Sex, higher education level, HCW type, direct exposure with confirmed infected cases
Chew et al. (48)	Asia-Pacific region	Cross-sectional	1,146 HCW (65.10)	COVID-19	29/04/2020–4/06/2020	DASS-21 to measure stress, depressive symptoms and anxiety, IES to measure post-traumatic stress disorder	NR	Sex
Chong et al. (13)	China	Cross-sectional	1,257 HCW (81.10)	SARS	12/05/2003–27/06/2003 6 weeks during outbreak	IES-R to measure post-traumatic stress disorder, CHQ to measure psychiatric morbidity	75.3 (psychiatric morbidity)	Sex, marital status, HCW type, work experience, exposure to confirmed infected cases

(Continued)

TABLE 1 | Continued

Study authors and year	Country	Study design	Sample (% female)	Infectious disease	Study period	Psychological distress measures	Rates of distress (%)	Risk/resilience factors tested
Civantos et al. (49)	Brazil	Cross-sectional	163 doctors (25.80)	COVID-19	14/05/2020–31/05/2020	GAD-7 to measure anxiety, IES-R to measure post-traumatic stress disorder, PHQ-2 to measure depressive symptoms, Mini-Z to measure physician burnout	14.7 (emotional burnout) 19.7 (moderate-severe anxiety) 26.3 (distress; PTSD) 16.3 (depression)	Age, sex
Cunill et al. (50)	Spain	Cross-sectional	1,452 HCW (82.90)	COVID-19	4/04/2020–10/04/2020 Peak of pandemic	GAD-7 to measure anxiety, PHQ-9 to measure depressive symptoms, PHQ-15 to measure physical symptoms related to distress	77.10 (emotional burnout) 63.4 (distress) 88.4 (anxiety) 86.1 (depression)	Sex, HCW type
Demirjian et al. (51)	USA	Cross-sectional	689 doctors (47.00)	COVID-19	3/04/2020–11/04/2020 8 days	Study specific measures for anxiety and stress	61.0 (anxiety)	Sex, Hospital resources/protection/training for the treatment of infection
Di Tella et al. (52)	Italy	Cross-sectional	145 doctors and nurses (72.40)	COVID-19	19/03/2020–05/04/2020	PCL-5 to measure PTSD, BDI-II to measure depressive symptoms, STAI to measure anxiety	NR	Exposure to confirmed infected cases
Dobson et al. (53)	Australia	Cross-sectional	320 HCW (78.50)	COVID-19	16/04/2020–13/05/2020	PHQ-9 to measure depressive symptoms, GAD-7 to measure anxiety, IES-R to measure post-traumatic stress disorder, PFI to measure burnout	2126.2 (distress: PTSD) 31.0 (moderate-severe depression) 71.0 (anxiety) 29.0 (distress: PTSD)	Adaptive personality traits, less work experience, direct contact with confirmed infected cases
Elbay et al. (54)	Turkey	Cross-sectional	442 HCW (56.80)	COVID-19	10/03/2020–15/03/2020	DASS-21 to measure depressive symptoms, stress and anxiety	64.7 (depression) 51.6 (anxiety) 41.2 (stress)	Age, sex, marital status, less work experience, social support-professional/organizational, hospital resources, protection, training, at risk of being in contact with infected patients
Elhadi et al. (55)	Libya	Cross-sectional	745 doctors and nurses (51.90)	COVID-19	18/04/2020–28/04/2020	HADS to measure anxiety and depression	56.3 (depression) 46.7 (anxiety)	Age, sex, marital status, less work experience, stigma
Elkholy et al. (56)	Egypt	Cross-sectional	502 HCW (50.00)	COVID-19	April–May 2020	GAD-7 to measure anxiety, PHQ-9 to measure depressive symptoms, PSS to measure level of perceived stress	76.4 (anxiety) 77.2 (depression) 80.9 (stress)	Sex

(Continued)

TABLE 1 | Continued

Study authors and year	Country	Study design	Sample (% female)	Infectious disease	Study period	Psychological distress measures	Rates of distress (%)	Risk/resilience factors tested
Erquicia et al. (57)	Spain	Cross-sectional	395 HCW (73.60)	COVID-19	March–April 2020	DASS-21 to measure stress, depressive symptoms and anxiety, HARS to measure anxiety, MADRS to measure depressive symptoms	31.4 (moderate-severe anxiety) 12.1 (moderate-severe depression) 14.5 (moderate-severe stress)	Age, sex, marital status, direct contact with confirmed infected cases
Fauzi et al. (58)	Malaysia	Cross-sectional	1,050 doctors (71.50)	COVID-19	May 2020 1 month	DASS-21 to measure stress, depressive symptoms and anxiety	31.0 (depression) 29.7 (anxiety) 23.5 (stress)	Perceived control, adaptive coping styles
Fiksenbaum et al. (59)	Canada	Cross-sectional	333 nurses (94.59)	SARS	03/2004–05/2004	Study specific measures on worry about contracting SARS, MBI GS to assess extent of emotional exhaustion	NR	Social support-professional/organizational, direct contact with infected cases, time spent in quarantine
García-Fernández et al. (60)	Spain	Cross-sectional	781 HCW (NR)	COVID-19	29/03/2020–05/04/2020 1 week during the peak of the outbreak	HAM-A to measure anxiety, BDI to measure depressive symptoms, ASDI to measure stress	NR	Work experience, Adequate information, Hospital resources, protection, training
Giardino et al. (61)	Argentina	Cross-sectional	1,059 HCW (72.70)	COVID-19	5/06/2020–25/06/2020	GADS to measure anxiety and depression	81.0 (depression) 76.5 (anxiety)	Age, sex, HCW type, direct contact with confirmed infected cases
Giusti et al. (62)	Italy	Cross-sectional	330 HCW (62.60)	COVID-19	16/04/2020–11/05/2020	STAI to measure anxiety, DASS-21 to measure stress, depressive symptoms and anxiety, IES-6 to measure post-traumatic stress disorder, MBI to measure burnout	71.2 (anxiety) 26.8 (depression) 34.3 (stress) 36.7 (distress; PTSD)	Sex, HCW type, social support-personal, direct contact with confirmed infected cases
Goulia et al. (63)	Greece	Cross-sectional	469 HCW (68.40)	H1N1	1/09/2009–30/09/2009 At the beginning of the second wave of the pandemic	GHQ-28 to measure psychological distress, study specific measure of worry about H1N1	27.5 (mild to severe psychological distress) 56.7 (worry)	HCW type, stigma, adequate information, positive work attitudes
Grace et al. (64)	Canada	Cross-sectional	193 physicians (32.10)	SARS	During the SARS outbreak in 2003	Study specific question about new distressing psychological symptoms	18.1 (new distressing symptoms)	Direct contact with confirmed infected cases
Gupta et al. (65)	India	Cross-sectional	1,124 HCW (36.10)	COVID-19	30/03/2020–2/04/2020 4 days	HADS to measure anxiety and depression	37.2 (anxiety) 31.4 (depression)	Age, sex, marital status, higher education level, HCW type, less experience, direct contact with infected cases, hospital resources, protection, training
Han et al. (66)	China	Cross-sectional	21,199 nurses (98.60)	COVID-19	7/02/2020–10/02/2020	SAS to measure anxiety, SDS to measure depressive symptoms	3.9 (moderate anxiety) 0.8 (severe anxiety) 6.9 (moderate depression) 1.3 (severe depression)	Sex, age, marital status, direct contact with infected cases, at risk of being in contact with infected patients,

(Continued)

TABLE 1 | Continued

Study authors and year	Country	Study design	Sample (% female)	Infectious disease	Study period	Psychological distress measures	Rates of distress (%)	Risk/resilience factors tested
Hasan et al. (67)	Pakistan	Cross-sectional	151 doctors (56.30)	COVID-19	30/04/2020–16/05/2020	GAD-7 to measure anxiety	14.6 (moderate anxiety) 3.3. (severe anxiety)	Sex, direct contact with confirmed cases
Ho et al. (68) Sample 1	Hong Kong	Cross-sectional	82 HCW (56.09)	SARS	5/04/03–5/05/03 During height of outbreak	Study specific measures of worry about contracting SARS	NR	Perceived control
Ho et al. (68) Sample 2	Hong Kong	Cross-sectional	97 HCW (82.50)	SARS	Sample 2 08/2003	CIES-R to measure post-traumatic stress disorder	NR	Perceived control
Holton et al. (69)	Australia	Cross-sectional	688 HCW (85.00)	COVID-19	15/05/2020–10/06/2020	DASS-21 to measure stress, depressive symptoms and anxiety	25.0 (psychological distress)	Sex, marital status, less experience, direct contact with confirmed infected cases
Hong et al. (70)	China	Cross-sectional	4,692 nurses (96.90)	COVID-19	8/02/2020–14/02/2020 2 weeks after the authority in Wuhan suspended all public transport on 23/01/2020	PHQ-9 to measure depressive symptoms, GAD-7 to measure anxiety	9.4 (depressive symptoms) 8.1 (anxiety)	Marital status, higher education level, social support-personal, social support-professional and organizational, perceived risk
Hosseinzadeh-Shanjani et al. (71)	Iran	Cross-sectional	200 HCW (80.00)	COVID-19	March 2020–May 2020	DASS-21 to measure stress, depressive symptoms and anxiety	NR	Age, sex, marital status, higher education level,
Hu et al. (72)	China	Cross-sectional	2,014 nurses (87.10)	COVID-19	13/02/2020–24/02/2020 At the peak of the outbreak	MBI-HSS to measure burnout, SAS to measure anxiety, SDS to measure depressive symptoms	60.5 (emotional exhaustion) 14.3 (anxiety) 10.7 (depression)	Age, sex, marital status, social support-personal, higher education level, less work experience, social support-personal, perceived control, adaptive personality traits, at risk of being in contact with infected patients, hospital resources, protection, training
Huang et al. (73)	China	Cross-sectional	587 mixture of radiology staff (52.00)	COVID-19	7/02/2020–9/02/2020	CPSS to measure stress, CSAS to measure anxiety	NR	Sex, marital status
Huffman et al. (74)	USA	Cross-sectional	720 HCW (NR)	COVID-19	21/04/2020 for 3 weeks Survey was open during the state of Indiana's peak day of COVID-19 cases on 26/04/2020	Grit-S to measure perceived grit	NR	Adaptive coping style, hospital resources, protection, training
Jain et al. (75)	India	Cross-sectional	512 anaesthesiologists (44.30)	COVID-19	12/05/2020–22/05/2020	GAD-7 to measure anxiety	74.2 (anxiety)	Age, sex, marital status, less work experience, direct contact with infected cases, hospital protection (PPE) for treatment of infected cases

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TABLE 1 | Continued

Study authors and year	Country	Study design	Sample (% female)	Infectious disease	Study period	Psychological distress measures	Rates of distress (%)	Risk/resilience factors tested
Ji et al. (76)	Sierra Leone	Cross-sectional	143 medical staff and students (49.50)	Ebola (EVD)	13/02/2015–19/03/2015 During Ebola outbreak	SCL-90-R to measure psychological symptoms	NR	Educational level
Jo et al. (77)	South Korea	Cross-sectional	253 HCW (83.00)	COVID-19	NR	IES-R to measure post-traumatic stress disorder	NR	Sex, HCW type
Juan et al. (78)	China	Cross-sectional	456 doctors and Nurses (70.60)	COVID-19	01/02/2020–14/02/2020	IES-R to measure post-traumatic stress disorder, GAD-7 to measure anxiety, PHQ-9 to measure depressive symptoms	37.5 (psychological distress) 31.6 (anxiety) 29.6 (depression)	Sex, age, level of education, HCW type, direct contact with infected cases, risk of contact with infected cases, stigma, social support-personal, time spent in quarantine
Jung et al. (79)	South Korea	Cross-sectional	147 nurses (NR)	MERS	1/10/2015–30/11/2015 Shortly after the MERS epidemic ended	IES-RK to measure post-traumatic stress disorder, GHQ-12 to measure mental health, study specific measure of stress	57.1 (distress: PTSD)	Social support-Professional/organizational
Khattak et al. (80)	Pakistan	Cross-sectional	380 nurses (84.21)	COVID-19	NR	CAPS to measure post-traumatic stress disorder,	NR	Social support-organizational/professional
Kim and Choi (81)	South Korea	Cross-sectional	223 ED nurses (93.50)	MERS	20/07/2015–31/07/2015. 2 months after the outbreak of MERS during uncontrolled disease period	OLBI to assess MERS-related burnout	NR	Age, sex, marital status, level of education, work experience, direct contact with infected cases, social support-personal, hospital resources, protection, training
Kim et al. (82)	South Korea	Cross-sectional	112 nurses (88.30)	MERS	30/06/2015–10/07/2015	IES to measure post-traumatic stress disorder, MBI-HSS to measure burnout.	50.0 (distress: PTSD)	Age, sex, marital status, higher level of education, less work experience
Koh et al. (83)	Singapore	Cross-sectional	7,614 HCW (82.00)	SARS	05/2003–07/2003 Toward the tail end of the pandemic	IES to measure post-traumatic stress disorder; single item to measure perceived stress at work	56.0 (stress)	HCW type, marital status, Stigma, exposure to SARS
Lai et al. (84)	China	Cross-sectional	1,257 HCW (76.70)	COVID-19	29/01/20–3/02/20 During pandemic	PHQ-9 to measure depression, GAD-7 to measure anxiety, CIES-R to measure post-traumatic stress disorder	50.4 (depression) 44.6 (anxiety) 71.5 (distress: PTSD)	Sex, HCW type, direct contact with confirmed infected cases

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TABLE 1 | Continued

Study authors and year	Country	Study design	Sample (% female)	Infectious disease	Study period	Psychological distress measures	Rates of distress (%)	Risk/resilience factors tested
Lee et al. (85)	South Korea	Cross-sectional	359 HCW (81.90)	MERS	05/32015–12/2015 During the outbreak	IES-R to measure post-traumatic stress	51.0 (distress: PTSD)	Sex, age, HCW type, at risk of being in contact with infected patients, time spent in quarantine
Leng et al. (86)	China	Cross-sectional	90 nurses (72.20)	COVID-19	11/03/2020–18/03/2020 At the time of the survey, nurses had worked in Wuhan for at least 32 days	CPSS to measure psychological distress, PCL-C to measure post-traumatic stress disorder	5.6 (distress: PTSD)	Sex, age, marital status, level of education, less work experience
Li et al. (87)	China	Cross-sectional	908 HCW (75.55)	COVID-19	3/02/2020–24/02/2020 Survey began 10 days after state of emergency declared on 23/01/2020	SAS to measure anxiety, SDS to measure depressive symptoms	24.34 (anxiety) 32.93 (depression)	Less work experience, direct contact with confirmed infected cases
Li et al. (88)	China	Cross-sectional	225 reserve medics (72.0)	COVID-19	4/04/2020–6/04/2020	IES-R to measure post-traumatic stress disorder, DASS-21 to measure depressive symptoms, stress and anxiety	46.7 (depression) 35.6 (anxiety) 16.0 (stress) 31.6 (distress: PTSD)	Sex, age social support-professional/organizational
Li et al. (89)	China	Cross-sectional	356 nurses (86.2)	COVID-19	01/2020–03/2020	PSS-10 to measure stress, PCL-5 to measure post-traumatic stress disorder	NR	Age, marital status, level of education, less work experience, job role, direct contact with infected cases, adaptive personality traits
Liao et al. (90)	China	Cross-sectional	1,092 nurses (99.51)	COVID-19	02/2020	SSAR to measure stress	NR	Age, sex, marital status, level of education, social support-personal, perceived control
Lin et al. (91)	China	Cross-sectional	114 HCW (79.80)	COVID-19	02/2020	HADS to measure anxiety and depression	NR	Adaptive and maladaptive coping styles, adaptive personality traits
Liu et al. (92)	China	Cross-sectional	549 HCW (75.2)	SARS	In 2006, 3 years after Beijing's SARS outbreak	CES-D to measure depressive symptoms	22.8 (moderate or severe depression)	Sex, age, marital status, altruistic perspective toward work, exposure to infection, being quarantined
Liu et al. (93)	China	Cross-sectional	512 HCW (79.96)	COVID-19	10/02/20–20/02/20 During pandemic	SAS to measure anxiety	12.5 (mild to severe anxiety)	Sex, age, marital status, level of education, HCW type, direct contact with confirmed infected cases
Liu et al. (94)	China	Cross-sectional	1,090 HCW (80.20)	COVID-19	24/02/2020–9/03/2020	PSS-10 to measure stress, GAD-7 to measure anxiety, PHQ-9 to measure depressive symptoms	13.3 (anxiety) 18.4 (depression) 23.9 (anxiety and depression)	Age, sex, marital status, HCW type, level of education, less experience, social support-personal

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TABLE 1 | Continued

Study authors and year	Country	Study design	Sample (% female)	Infectious disease	Study period	Psychological distress measures	Rates of distress (%)	Risk/resilience factors tested
Liu et al. (95)	China	Cross-sectional	2,031 doctors and Nurses (85.52)	COVID-19	17/02-2020–23/02/2020	DASS-21 to measure stress, depressive symptoms and anxiety	14.81 (depression) 18.3 (anxiety) 9.98 (stress)	Sex, age, HCW type, role, level of education, direct contact with confirmed infected cases
Lu et al. (96)	Taiwan	Cross-sectional	127 HCW (58.27)	SARS	07/2003–03/2004	CHQ to assess psychiatric morbidity	17.3 (psychiatric morbidity)	Neuroticism
Lu et al. (97)	China	Cross-sectional	2,042 HCW (77.90)	COVID-19	25/02/2020–26/02/2020	HAM-A to measure anxiety, HAM-D to measure depressive symptoms	NR	Direct contact with confirmed infected cases
Magnavita et al. (98)	Italy	Cross-sectional	595 HCW (70.10)	COVID-19	27/03/2020–30/04/2020	GADS to measure anxiety and depression	16.6 (anxiety) 20.3 (depression)	Age, sex, exposure to confirmed infected cases
Maraqa et al. (99)	Palestine	Cross-sectional	430 doctors, nurses, and allied health professionals (54.80)	COVID-19	29/03/2020–15/04/2020	Study specific measure of stress	74.0 (stress)	Age, sex, HCW type, marital status; married with children, direct contact with infected cases, social support-organizational, hospital resources, protection, training
Martínez-López et al. (100)	Spain	Cross-sectional	157 HCW (79.00)	COVID-19	6/04/2020–19/04/2020 Middle of lockdown in Spain and at peak of pandemic	MBI to measure burnout		Age, sex, HCW type, hospital resources (PPE) for treatment of infection
Marton et al. (101)	Italy	Cross-sectional	458 HCW (NR)	COVID-19	24/03/2020–13/05/2020 Phase 1 of Italian COVID-19 emergency	GHQ-12 to measure psychological distress	21.26 (psychological distress)	Age, less experience, perceived control
Master et al. (102)	China	Cross-sectional	263 nurses (76.70)	COVID-19	3/02/2020–11/02/2020	GHQ-12 to measure psychological distress, IES-R to measure post-traumatic stress disorder	25.1 (psychological distress)	Sex, age, level of education, marital status, less experience, adaptive and maladaptive coping styles, stigma, social support-personal, hospital resources, protection, training
Matsuishi et al. (103)	Japan	Cross-sectional	1,625 HCW (75.60)	H1N1	16/03/2009–31/07/2009 Approximately 1 month after the peak of outbreak	IES to measure post-traumatic stress disorder, study specific measures on stress	NR	Age, sex, HCW type, at risk of being in contact with infected patients
Maunder et al. (104)	Canada	Cross-sectional	1,557 HCW (74.60)	SARS	12/05/2003–20/06/2003 During the outbreak	IES to measure psychological stress	NR	Direct contact with infected cases, stigma

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TABLE 1 | Continued

Study authors and year	Country	Study design	Sample (% female)	Infectious disease	Study period	Psychological distress measures	Rates of distress (%)	Risk/resilience factors tested
Maunder et al. (14)	Canada	Cross-sectional	587 HCW (87.80)	SARS	23/10/2004–30/09/2005 13–26 months after outbreak	IES to measure post-traumatic stress disorder, K10 to measure non-specific psychological distress, MBI-EE to measure burnout	NR	Work experience, stigma, maladaptive coping styles, maladaptive personality traits, direct contact with infected cases, time spent in quarantine
McAlonan et al. (16)	Hong Kong	Cross-sectional across 2 time points	T1 = 176 T2 = 184 HCW (73.25, T1; 64.50, T2)	SARS	T1: 15/04/2003–15/05/2003. During the peak period of hospital admissions for SARS. T2: 2004	PSS-10 to measure stress, DASS-21 to measure stress, depressive symptoms and anxiety, IES-R to measure post-traumatic stress disorder	NR	At risk of being in contact with infected patients
Mo et al. (105)	China	Cross-sectional	200 nurses (89.00)	COVID-19	22/02/2020	SAS to measure subjective anxiety, SOS to measure stress	NR	Sex, marital status, level of education, perceived control, direct contact with confirmed infected cases
Mosheva et al. (106)	Israel	Cross-sectional	1,106 doctors (49.0)	COVID-19	19/03/2020–22/03/2020 Whilst confirmed cases were rising	Study specific measures of stress	NR	Marital status, hospital training for treatment of infection, adaptive personality traits
Nickell et al. (107)	Canada	Cross-sectional	510 HCW (78.80)	SARS	10/04/2003–22/04/2003 Conducted during the peak of the initial phase of the SARS outbreak	GHQ-12 to measure psychological distress	29.0 (distress)	HCW type, part-time work status
Park et al. (108)	South Korea	Cross-sectional	187 nurses (100.00)	MERS	30/08/2015–21/09/2015 Conducted during MERS epidemic	PSS to measure level of perceived stress, SF-36 MH to measure mental health status	NR	Marital status, work experience, stigma, adaptive personality traits
Park et al. (109)	South Korea	Cross-sectional	1,003 HCW (77.10)	COVID-19	2/04/2020–10/04/2020 Whilst cases were increasing	PHQ-9 to measure depressive symptoms, GAD-7 to measure anxiety	NR	HCW type, stigma, direct contact with infected cases, time spent in quarantine
Phua et al. (110)	Singapore	Cross-sectional	96 doctors and nurses (64.60)	SARS	1/11/2003–14/11/2003 6 months after the end of the outbreak	IES to measure post-traumatic stress disorder, GHQ-28 to measure psychiatric morbidity	18.8 (psychiatric morbidity), 17.7 (distress: PTSD)	HCW type, maladaptive coping styles
Podder et al. (111)	India	Cross-sectional	384 doctors (44.53)	COVID-19	03/04/2020–10/04/2020	PSS-10 to measure stress	85.6 (moderate and high stress)	Age, sex, marital status

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TABLE 1 | Continued

Study authors and year	Country	Study design	Sample (% female)	Infectious disease	Study period	Psychological distress measures	Rates of distress (%)	Risk/resilience factors tested
Poon et al. (112)	Hong Kong	Cross-sectional	1,926 HCW (NR)	SARS	05/2003–06/2003 Diagnosis of the first case of SARS occurred on 12/03/2003. Hong Kong declared SARS-free on 23/06/2003	STAI to measure anxiety, MBI-EE to measure emotional burnout	NR	HCW type, contact with confirmed infected cases
Pouralizadeh et al. (113)	Iran	Cross-sectional	441 nurses (95.20)	COVID-19	7/04/2020–12/04/2020	GAD-7 to measure anxiety, PHQ-9 to measure depressive symptoms	38.8 (anxiety) 37.4 (depression)	Age, sex, marital status, level of education, less work experience, risk of contact with infected cases, hospital resources, protection, training
Prasad et al. (114)	USA	Cross-sectional	347 HCW (90.80)	COVID-19	14/04.20202–25/04/2020	GAD-7 to measure anxiety, Mini Z to measure burnout, IES to measure distress, PHQ-2 to measure depressive symptoms	69.5 (anxiety) 84.1 (mild distress) 22.8 (depression)	Age, HCW role
Que et al. (115)	China	Cross-sectional	2,285 HCW (69.06)	COVID-19	16/02/2020–23/02/2020 Early stage of COVID-19 pandemic	GAD-7 to measure anxiety, PHQ-9 to measure depressive symptoms	46.0 (anxiety) 44.4 (depression)	Sex, at risk of being in contact with infected patients
Rodríguez-Menéndez et al. (116)	Spain	Cross-sectional	1,407 HCW (71.50)	COVID-19	11/05/2020–31/05/2020	GHQ-28 to measure distress, SASR to measure perceived anxiety	24.7 (acute stress)	Sex, age, HCW type, Hospital resources, protection, training, Social support – professional/organizational, adequate information
Romero et al. (117)	Spain	Cross-sectional	3,109 HCW (NR)	COVID-19	09/04/2020–19/04/2020 10 days during the outbreak	Study specific measure of stress	NR	Age
Rossi et al. (118)	Italy	Cross-sectional	1,379 HCW (77.20)	COVID-19	27/03/2020–31/03/2020 Days immediately preceding the peak 77.2 of the COVID-19 outbreak in Italy	GAD-7 to measure anxiety, PSS to assess perceived stress, PHQ-9 to measure depressive symptoms, GPS to assess post-traumatic stress symptoms (PTSS)	49.4 (distress: PTSD)	Sex, age, HCW type, colleagues being infected, quarantined, deceased
Ruiz-Fernández et al. (119)	Spain	Cross-sectional	506 doctors and nurses (76.70)	COVID-19	30/03/2020–16/04/2020	PSS-14 to measure stress	NR	Sex, marital status, HCW type, part-time work, direct contact with confirmed infected cases
Sagaon-Teyssier et al. (120)	Mali	Cross-sectional	135 HCW (39.30)	COVID-19	6/04/2020–11/04/2020	GAD-7 to measure anxiety, PHQ-9 to measure depressive symptoms	NR	Sex, marital status, HCW type, hospital resources, protection, training

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TABLE 1 | Continued

Study authors and year	Country	Study design	Sample (% female)	Infectious disease	Study period	Psychological distress measures	Rates of distress (%)	Risk/resilience factors tested
Sahin et al. (121)	Turkey	Cross-sectional	939 HCW (66.00)	COVID-19	23/04/2020–23/05/2020	GAD-7 to measure anxiety, IES-R to measure post-traumatic stress disorder, PHQ-9 to measure depressive symptoms	77.6 (depression) 60.2 (anxiety) 76.4 (psychological distress)	Sex, age, HCW type, less work experience, risk of contact with infected cases
Saricam (122)	Turkey	Cross-sectional	123 nurses (74.00)	COVID-19	10/04/2020–20/04/2020	STAI to measure anxiety	46.3 (anxiety)	Sex, age, marital status, less work experience, direct contact with confirmed infected cases
Shahrour and Dardas (123)	Jordan	Cross-sectional	448 nurses (73.00)	COVID-19	NR	SAS to measure anxiety, BSI-18 to measure psychological distress	64.0 (acute stress) 41.0 (significant psychological distress)	Sex, age, perceived control
Shechter et al. (124)	USA	Cross-sectional	657 HCW (70.90)	COVID-19	09/04/2020–24/04/2020	GAD-2 to measure anxiety, PHQ-2 to measure depressive symptoms, PC-PTSD to measure acute stress	57.0 (acute stress) 48.0 (depression) 33.0 (anxiety)	HCW type
Si et al. (125)	China	Cross-sectional	863 HCW (70.70)	COVID-19	23/02/2020–5/03/2020	IES-6 to measure post-traumatic stress disorder, DASS-21 to measure stress, depressive symptoms and anxiety	13.6 (depression) 13.9 (anxiety) 8.6 (stress)	Sex, age, marital status, level of education, HCW type, direct contact with infected cases, time spent in quarantine
Son et al. (126)	South Korea	Cross-sectional	153 HCW hospital staff (74.30)	MERS	25/08/2015–14/09/2015 Approximately 1 month after the end of the outbreak on 28/07/2015	IES-RK to measure post-traumatic stress disorder	18.6 (distress: PTSD)	Loss of control and perceived risk, adaptive coping styles and ability
Song et al. (127)	China	Cross-sectional	14,825 doctors and nurses (64.30)	COVID-19	28/02/2020–18/03/2020	CES-D to measure depression, PCL-5 to measure post-traumatic stress disorder (PTSD)	25.2 (depression) 9.1 (PTSD)	Age, sex, marital status, HCW type, less work experience, social support-personal
Sorokin et al. (128)	Russia	Cross-sectional	1,800 HCW Phase 1: 223 (79.50) Phase 2: 1577 (89.50)	COVID-19	1st week of self-isolation Phase 1: 30/03/2020–5/04/2020 Phase 2: 4/05/2020–10/05/2020	PSM-25 to measure anxiety and distress	NR	Marital status, HCW type, direct contact with confirmed infected cases
Stojanov et al. (129)	Serbia	Cross-sectional	201 HCW Group 1: 118 (65.60) Group 2: 83 (66.30)	COVID-19	NR	GAD-7 to measure anxiety, SDS to measure depressive symptoms	NR	Direct contact with confirmed infected cases

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TABLE 1 | Continued

Study authors and year	Country	Study design	Sample (% female)	Infectious disease	Study period	Psychological distress measures	Rates of distress (%)	Risk/resilience factors tested
Styra et al. (130)	Canada	Cross-sectional	248 HCW (87.02)	SARS	16/06/2003–9/07/2003	IES-R to measure post-traumatic stress disorder	NR	Age, sex, marital status, work experience, adequate information, at risk of being in contact with infected patients
Sun et al. (131)	China	Cross-sectional	536 HCW (69.00)	COVID-19	2/03/2020–6/03/2020	PHQ-9 to measure depressive symptoms, GAD-7 to measure anxiety,	NR	Age, sex, marital status, colleagues being infected/quarantined, direct contact with confirmed infected cases
Sun et al. (132)	China	Cross-sectional	442 HCW (84.30)	COVID-19	31/01/2020–4/02/2020	IES to measure post-traumatic stress disorder	NR	Age, sex, marital status, HCW type, less work experience, at risk of being in contact with infected patients, direct contact with infected cases, time spent in quarantine
Surrati et al. (133)	Saudi Arabia	Cross-sectional	122 HCW (64.40)	COVID-19	04/2020–05/2020	HADS to measure anxiety and depression, PSS to measure perceived stress	35.6 (anxiety) 27.9 (depression) 72.8 (moderate stress)	Sex, HCW type, direct contact with infected cases, hospital resources, protection, training
Tam et al. (134)	Hong Kong	Cross-sectional	652 front-line Hospital HCW (79.00)	SARS	06/2003–08/2003	GHQ-12 to measure psychological distress, Study specific measure for job-related stress	56.7 (psychological distress) 68.0 (stress)	HCW type, age, sex, social support-personal, direct contact with infected cases, hospital resources, protection, training
Tan et al. (135)	Singapore	Cross-sectional	3,075 HCW (71.50)	COVID-19	29/05/2020–24/06/2020	OLBI to measure burnout, HADS to measure anxiety and depression	NR	Sex, HCW type, level of education, positive work attitudes
Tang et al. (136)	China	Cross-sectional	102 HCW (66.70)	H7N9	01/2015 and 05/2016	PCL-C to measure post-traumatic stress disorder	20.6 (distress: PTSD)	Age, sex, HCW type, direct contact with infected cases, hospital resources, protection, training
Teshome et al. (137)	South Ethiopia	Cross-sectional	798 HCW (39.60)	COVID-19	20/05/2020–20/06/2020	GAD-7 to measure anxiety	NR	Direct contact with confirmed infected cases
Teskin et al. (138)	Turkey	Cross-sectional	452 HCW (66.20)	COVID-19	20/05/2020–10/06/2020	HADS to measure anxiety and depression	NR	Stigma
Tselebis et al. (139)	Greece	Cross-sectional	150 nurses (80.00)	COVID-19	5/2020 Last 2 weeks	PSS to measure perceived stress	50.3 (stress)	Age, sex, less experience, social support-personal, direct contact with confirmed infected cases
Tu et al. (140)	China	Cross-sectional	100 nurses (100.00)	COVID-19	07/02/2020–25/02/2020 In the initial stage of the outbreak when there was a shortage of nurses	GAD-7 to measure anxiety, PHQ-9 to measure depressive symptoms	40.0 (anxiety) 46.0 (depression)	Age, marital status, level of education, less work experience
Uyaroglu et al. (141)	Turkey	Cross-sectional	113 doctors (46.90)	COVID-19	1/04/2020–14/04/2020	GAD-7 to measure anxiety, Beck Inventory to measure anxiety and depressive symptoms	NR	Sex, age, marital status, direct contact with confirmed infected cases

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TABLE 1 | Continued

Study authors and year	Country	Study design	Sample (% female)	Infectious disease	Study period	Psychological distress measures	Rates of distress (%)	Risk/resilience factors tested
Vagni et al. (142)	Italy	Cross-sectional	210 HCW (57.10)	COVID-19	NR	STSS to measure work related stress, study specific measure (Emergency Stress Questionnaire) of stress	NR	Age, sex, HCW type, adaptive coping styles, adequate information
Veeraraghavan and Srinivasan (143)	India	Cross-sectional	100 doctors (44.00)	COVID-19	04/2020–05/2020 Before the peak of the pandemic	Beck Depression Inventory to measure anxiety and depression,	14.0 (moderate anxiety) 15.0 (moderate depression) 2.0 (severe depression)	Sex, direct contact with confirmed infected cases
Verma et al. (144)	Singapore	Cross-sectional	721 doctors (38.80)	SARS	05/2003 2 months after the first case of SARS was reported in Singapore	GHQ-28 to measure psychological distress, IES-R to measure post-traumatic stress disorder	14.1 (psychological distress)	Age, stigma, direct contact with confirmed infected cases
Wang et al. (145)	China	Cross-sectional	202 nurses (87.60)	COVID-19	02/2020–03/2020	PCL-C to measure PTSD	16.8 (distress: PTSD)	Sex, marital status, level of education, adaptive coping styles and adaptability, maladaptive coping styles, positive work attitudes
Wang et al. (146)	China	Cross-sectional	1,045 HCW (85.80)	COVID-19	02/02/2020–03/02/2020	HADS to measure anxiety and depression, PSS-14 to measure perceived stress	13.6 (moderate to severe depression) 20.0 (moderate to severe anxiety)	Sex, HCW type, level of education, less experience, direct contact with infected cases, risk of being in contact with infected cases
Wilson et al. (147)	India	Cross-sectional	350 HCW (46.60)	COVID-19	10/04/2020–25/04/2020	GAD-7 to measure anxiety, PHQ-9 to measure depressive symptoms, PSS-10 to measure distress	17.7 (moderate and severe anxiety) 11.4 (severe depression) 3.7 (high levels of stress)	Sex
Wong et al. (148)	Hong Kong	Cross-sectional	466 ED nurses and doctors (65.70)	SARS	24/06/2003–24/07/2003	Study specific measures on distress caused by SARS	NR	HCW type, loss of control and perceived risk
Xiao et al. (10)	China	Cross-sectional	180 HCW treating patients with COVID-19 (71.70)	COVID-19	01/2020–02/2020	SASR to measure perceived stress, SAS to measure anxiety	NR	Social support-personal, perceived control
Xing et al. (149)	China	Cross-sectional	309 HCW (97.40)	COVID-19	7/02/2020–21/02/2020	SAS to measure anxiety, SDS to measure depression,	28.5 (anxiety) 56.0 (depression)	Age, marital status, level of education, HCW type, direct contact with confirmed infected cases
Xiong et al. (150)	China	Cross-sectional	223 Nurses (97.30)	COVID-19	16/02/2020–25/02/2020	GAD-7 to measure anxiety, PHQ-9 to measure depressive symptoms	40.8 (anxiety) 26.4 (depression)	Age, sex, level of education, less work experience, role type, direct contact with infected cases,, perceived control

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TABLE 1 | Continued

Study authors and year	Country	Study design	Sample (% female)	Infectious disease	Study period	Psychological distress measures	Rates of distress (%)	Risk/resilience factors tested
Yao et al. (151)	China	Cross-sectional	1,002 HCW (85.20)	COVID-19	1/02/2020–20/02/2020	GHQ-12 to measure psychological distress	61.1 (psychological distress)	Age, sex, marital status, level of education, HCW type, less work experience, direct contact with infected cases, risk of contact with infected cases
Yin et al. (152)	China	Cross-sectional	377 HCW (61.50)	COVID-19	01/02/2020–05/02/2020 During the early stages of the pandemic	PCL-5 to measure post-traumatic stress symptoms (PTSS)	3.8 (distress: PTSD)	Sex, education level, HCW type, direct contact with confirmed infected cases
Yörük and Güler (153)	Turkey	Cross-sectional	377 midwives and nurses (NR)	COVID-19	30/05/2020–13/06/2020 2 weeks	MBI-HSS to measure burnout, Beck Depression Inventory to measure depression, PSS to measure perceived stress	31.8 (depression)	Age, level of education, marital status, less work experience, direct contact with infected cases, adaptive personality traits
Youssef et al. (154)	Egypt	Cross-sectional	540 HCW (45.60)	COVID-19	04/2020	DASS-21 to measure depressive symptoms, stress and anxiety	37.2 (mild-severe stress) 59.0 (depression) 42.6 (anxiety)	Age, sex, marital status, level of education, less work experience
Zhang et al. (155)	China	Cross-sectional	927 HCW (64.96)	COVID-19	19/02/2020–06/03/2020 8 weeks after the outbreak in Wuhan	SCL-90-R to measure psychological symptoms, PHQ-4 to measure anxiety and depressive symptoms	NR	Sex, at risk of being in contact with infected patients
Zhang et al. (156)	China	Cross-sectional	678 HCW (85.05)	COVID-19	6/06/2020–13/06/2020	PCL-C to measure post-traumatic stress disorder, HADS to measure depression and anxiety	41.87 (anxiety) 27.61 (depression)	Sex, age, marital status, level of education, HCW type, direct contact with confirmed infected cases, time spent in quarantine, social support-personal

COVID-19, Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2); H1N1, influenza A virus subtype H1N1; MERS, Middle East respiratory syndrome; SARS, severe acute respiratory syndrome; ED, Emergency Department; HCW, A mixture of nurses, doctors, and health related staff in a hospital; NR, not reported; HRW, high-risk workers in COVID wards; LRW, low-risk workers in non-COVID wards.

Measures used in studies: ASDI, Acute Stress Disorder Inventory; BDI, Beck Depression Inventory; BDI-II, Beck Depression Inventory 1996 revision; BSI-18, Brief Symptom Inventory; CAPS, Clinician Administered PTSD Scale; CES-D, Center for Epidemiology Scale for Depression; CHQ, Chinese Health Questionnaire; CMBI, Chinese version of Maslach Burnout Inventory; CIES-R, Chinese Impact of Event Scale—Revised; CPSS, Chinese Perceived Stress Scale; CSAS, Chinese Self-Rating Anxiety Scale; DASS, Depression Anxiety and Stress Scale 42-item; DASS-21, Depression; Anxiety and Stress Scale 21-item; GAD-2, Generalized Anxiety Disorder Scale 2-item; GAD-7, Generalized Anxiety Disorder scale 7-item; GADS, Goldberg Anxiety and Depression Scale; GHQ-12, General Health Questionnaire 12-item; GHQ-28, General Health Questionnaire 28-item; GPS, Global Psychotrauma Screen; Grit-S, Short Grit Scale; HADS, Hospital Anxiety and Depression Scale; HAM-A:HAM-A; Hamilton Anxiety Scale; HAM-D, Hamilton Depression Scale; HARS, Hamilton Rating Scale for Anxiety; IES, Impact of Events Scale; IES-6, Impact of Event Scale for Post-Traumatic Stress Disorder 6-item; IES-R, Impact of Events Scale for Post-Traumatic Stress Disorder; IES-RK, Impact of Event Scale revised Korean version; K-10, Kessler Psychological Distress Scale 10-item; K-6, Kessler Psychological Distress Scale 6-item; MADRS, Montgomery-Asberg Depression Rating Scale; MBI, Maslach Burnout Inventory; MBI-EE, emotional exhaustion scale of the Maslach Burnout Inventory; MBI GS, Maslach Burnout Inventory—General Survey; MBI HSS, Maslach Burnout Inventory-Human Services Survey; Mini-Z, Z Clinician Questionnaire (for “Zero” Burnout); OLB, Oldenburg Burnout Inventory; PCL-5, Post-traumatic Stress Disorder Check List (for DSM 5); PCL-C, Post-Traumatic Stress Disorder Checklist-Civilian Version; PDI, Peritraumatic Distress Inventory; PHQ-2, Patient Health Questionnaire 2-item; PHQ-4, Patient Health Questionnaire 4-item; PHQ-9, 9-item Patient Health Questionnaire; PHQ-15, Patient Health Questionnaire Physical Symptoms 15-item; PC-PTSD, Primary Care Post-Traumatic Stress Disorder Screen for DSMIV; PSS, Perceived Stress Scale; PSS-10, Perceived Stress Scale 10-item; PSS-14, Perceived Stress Scale 14-item; Psychological Stress Measure 25-item; PTSD-8, Post-Traumatic Stress Disorder 8-item; SAS, Self-Rating Anxiety Scale; SASR, Stanford Acute Stress Reaction scale; SCL-90-R, Symptoms Checklist 90-items; Revised; Chinese version; SDS, Zung Self-Rating Depression Scale Chinese version; SF-36 MH, Short Form Survey mental health component; SOS, Stress Overload Scale; STAI, State-Trait Anxiety Inventory; STSS, Secondary Traumatic Stress Scale.

TABLE 2 | Overview of the evidence for the factors associated with risk and resilience for psychological distress in health-care workers.

Factor	Evidence for risk	Evidence for resilience	Non-significant findings
Fixed—Demographics			
Younger age	Abdulah and Mohammed (23), Al Mahiyari et al. (26), Alan et al. (27), Arafa et al. (28), Azoulay et al. (30), Badahdah et al. (32), Chatterjee et al. (42), Civantos et al. (49), Elbay et al. (54), Elhadi et al. (55), Erquicia et al. (57), Giardino et al. (61), Gupta et al. (65), Hosseinzadeh-Shanjani et al. (71), Jain et al. (75), Juan et al. (78), Li et al. (89), Liao et al. (90), Liu et al. (92), Matsuishi et al. (103), Romero et al. (117), Rossi et al. (118), Sahin et al. (121), Shahrour and Dardas (123), Song et al. (127), Sun et al. (131), Tam et al. (134), Tang et al. (157), Verma et al. (144), Xing et al. (149), Yörük and Güler (153), Youssef et al. (154)	Caillet et al. (40), Han et al. (66), Leng et al. (86), Liu et al. (95), Master et al. (102), Prasad et al. (114), Saricam (122), Sun et al. (132)	Arshad et al. (29), Blekas et al. (36), Cai et al. (38), Chen et al. (47), Chen et al. (45), Chew et al. (48), Chong et al. (13), Dobson et al. (53), Elkholy et al. (56), Hu et al. (72), Kim and Choi (81), Kim et al. (82), Lee et al. (85), Li et al. (88), Liu et al. (93), Liu et al. (94), Magnavita et al. (98), Maraqa et al. (99), Martínez-López et al. (100), Marton et al. (101), Podder et al. (111), Pouralizadeh et al. (113), Rodríguez-Menéndez et al. (116), Si et al. (125), Styra et al. (130), Tselebis et al. (139), Tu et al. (140), Uyaroglu et al. (141), Vagni et al. (142), Xiong et al. (150), Yao et al. (151), Yin et al. (152), Zhang et al. (156)
Female sex	Abdulah and Mohammed (23), Alan et al. (27), Arafa et al. (28), Arshad et al. (29), Azoulay et al. (30), Babore et al. (31), Badahdah et al. (32), Bettinsoli et al. (35), Blekas et al. (36), Bukhari et al. (37), Caillet et al. (40), Chen et al. (46), Chong et al. (13), Civantos et al. (49), Cunill et al. (50), Demirjian et al. (51), Elbay et al. (54), Elkholy et al. (56), Erquicia et al. (57), Giardino et al. (61), Guisti et al. (62), Gupta et al. (65), Han et al. (66), Hasan et al. (67), Holton et al. (69), Hosseinzadeh-Shanjani et al. (71), Hu et al. (72), Huang et al. (73), Jain et al. (75), Jo et al. (77), Juan et al. (78), Lai et al. (84), Lee et al. (85), Liao et al. (90), Liu et al. (93), Magnavita et al. (98), Matsuishi et al. (103), Podder et al. (111), Pouralizadeh et al. (113), Rodríguez-Menéndez et al. (116), Rossi et al. (118), Ruiz-Fernández et al. (119), Sahin et al. (121), Sun et al. (132), Surrati et al. (133), Tam et al. (134), Tang et al. (157), Sagaon-Teyssier et al. (120), Tselebis et al. (139), Uyaroglu et al. (141), Vagni et al. (142), Wang et al. (145), Wilson et al. (147), Yao et al. (151), Yin et al. (152), Youssef et al. (154), Zhang et al. (155), Zhang et al. (156)	Song et al. (127), Liu et al. (95), Veeraraghavan and Srinivasan (143)	Aksoy and Koçak (25), Al Mahiyari et al. (26), Barelo et al. (33), Cai et al. (38), Chatterjee et al. (42), Chen et al. (47), Chen et al. (45), Chew et al. (48), Elhadi et al. (55), Elkholy et al. (56), Kim and Choi (81), Kim et al. (82), Lai et al. (84), Leng et al. (86), Li et al. (88), Liu et al. (92), Liu et al. (94), Maraqa et al. (99), Martínez-López et al. (100), Master et al. (102), Mo et al. (105), Que et al. (115), Saricam (122), Shahrour and Dardas (123), Si et al. (125), Styra et al. (130), Sun et al. (132), Tan et al. (135), Wang et al. (146), Xiong et al. (150)
Marital status—married with children	Koh et al. (83), Erquicia et al. (57), Han et al. (66), Holton et al. (69), Hu et al. (72), Saricam (122)	Elbay et al. (54)	Alan et al. (27), Babore et al. (31), Bettinsoli et al. (35), Cai et al. (38), Maraqa et al. (99), Mo et al. (105), Mosheva et al. (106), Pouralizadeh et al. (113), Sun et al. (132), Uyaroglu et al. (141), Xing et al. (149), Yörük and Güler (153)
Marital status—single vs. married	Azoulay et al. (30), Chan and Huak (41), Elbay et al. (54), Gupta et al. (65), Hong et al. (70), Huang et al. (73), Liu et al. (95), Podder et al. (111), Song et al. (127), Sorokin et al. (128), Sun et al. (131), Yao et al. (151), Youssef et al. (154)	Han et al. (66), Jain et al. (75), Li et al. (89), Liu et al. (94)	Babore et al. (31), Badahdah et al. (32), Bettinsoli et al. (35), Cai et al. (38), Chen et al. (47), Chong et al. (13), Elhadi et al. (55), Gupta et al. (65), Hasan et al. (67), Hosseinzadeh-Shanjani et al. (71), Hu et al. (72), Juan et al. (78), Kim and Choi (81), Kim et al. (82), Koh et al. (83), Leng et al. (86), Liao et al. (90), Liu et al. (93),

(Continued)

TABLE 2 | Continued

Factor	Evidence for risk	Evidence for resilience	Non-significant findings
Higher education level	Sun et al. (131), Tan et al. (135), Youssef et al. (154)	Alan et al. (27), Han et al. (66), Hong et al. (70), Ji et al. (76), Kim and Choi (81), Li et al. (89), Liu et al. (94), Xing et al. (149), Yao et al. (151)	Maraqa et al. (99), Master et al. (102), Mo et al. (105), Park et al. (108), Pouralizadeh et al. (113), Ruiz-Fernández et al. (119), Saricam (122), Si et al. (125), Styra et al. (130), Sun et al. (132), Sagaon-Teyssier et al. (120), Tu et al. (140), Uyaroglu et al. (141), Wang et al. (145), Xing et al. (149), Yörük and Güler (153), Zhang et al. (156)
Fixed—Occupational			
Nurse vs. physician	Alan et al. (27), Barelo et al. (33), Bates et al. (34), Bettinsoli et al. (35), Chong et al. (13), Cunill et al. (50), Guisti et al. (62), Goulia et al. (63), Gupta et al. (65), Holton et al. (69), Jo et al. (77), Koh et al. (83), Lai et al. (84), Lee et al. (85), Liu et al. (94), Martínez-López et al. (100), Matsuishi et al. (103), Maunder et al. (104), Nickell et al. (107), Park et al. (109), Phua et al. (110), Prasad et al. (114), Poon et al. (112), Shechter et al. (124), Si et al. (125), Song et al. (127), Tam et al. (134), Tan et al. (135), Tang et al. (157), Vagni et al. (142), Wong et al. (148), Xing et al. (149), Yao et al. (151), Zhang et al. (156)	Chan and Huak (41), Chong et al. (13), Liu et al. (95), Ruiz-Fernández et al. (119), Sorokin et al. (128)	Al Mahyijari et al. (26), Badahdah et al. (32), Cai et al. (38), Caillet et al. (40), Chen et al. (47), Chen, et al. (45), Giardino et al. (61), Juan et al. (78), Liu et al. (93), Maraqa et al. (99), Rodríguez-Menéndez et al. (116), Rossi et al. (118), Sun et al. (132), Surrati et al. (133), Wang et al. (146), Yin et al. (152)
Less work experience	Abdulah and Mohammed (23), Arafa et al. (28), Chatterjee et al. (42), Chong et al. (13), Elbay et al. (54), Elhadi et al. (55), Gupta et al. (65), Holton et al. (69), Li et al. (89), Maunder et al. (14), Song et al. (127), Youssef et al. (154)	Sahin et al. (121), Saricam (122)	Cai et al. (38), Dobson et al. (53), García-Fernández et al. (60), Hu et al. (72), Kim and Choi (81), Kim et al. (82), Koh et al. (83), Leng et al. (86), Liu et al. (94), Maraqa et al. (99), Marton et al. (101), Master et al. (102), Park et al. (108), Pouralizadeh et al. (113), Styra et al. (130), Sun et al. (132), Tselebis et al. (139), Tu et al. (140), Wang et al. (146), Xiong et al. (150), Yörük and Güler (153)
Part-time work status	Nickell et al. (107)		Ruiz-Fernández et al. (119)
Modifiable—Social			
Social support—personal		Arafa et al. (28), Babore et al. (31), Cai et al. (39), Cai et al. (38), Chen et al. (44), Guisti et al. (62), Hong et al. (70), Hu et al. (72), Juan et al. (78), Kim and Choi (81), Li et al. (88), Liao et al. (90), Liu et al. (94), Master et al. (102), Song et al. (127), Tam et al. (134), Tselebis et al. (139), Xiao et al. (10), Zhang et al. (156)	

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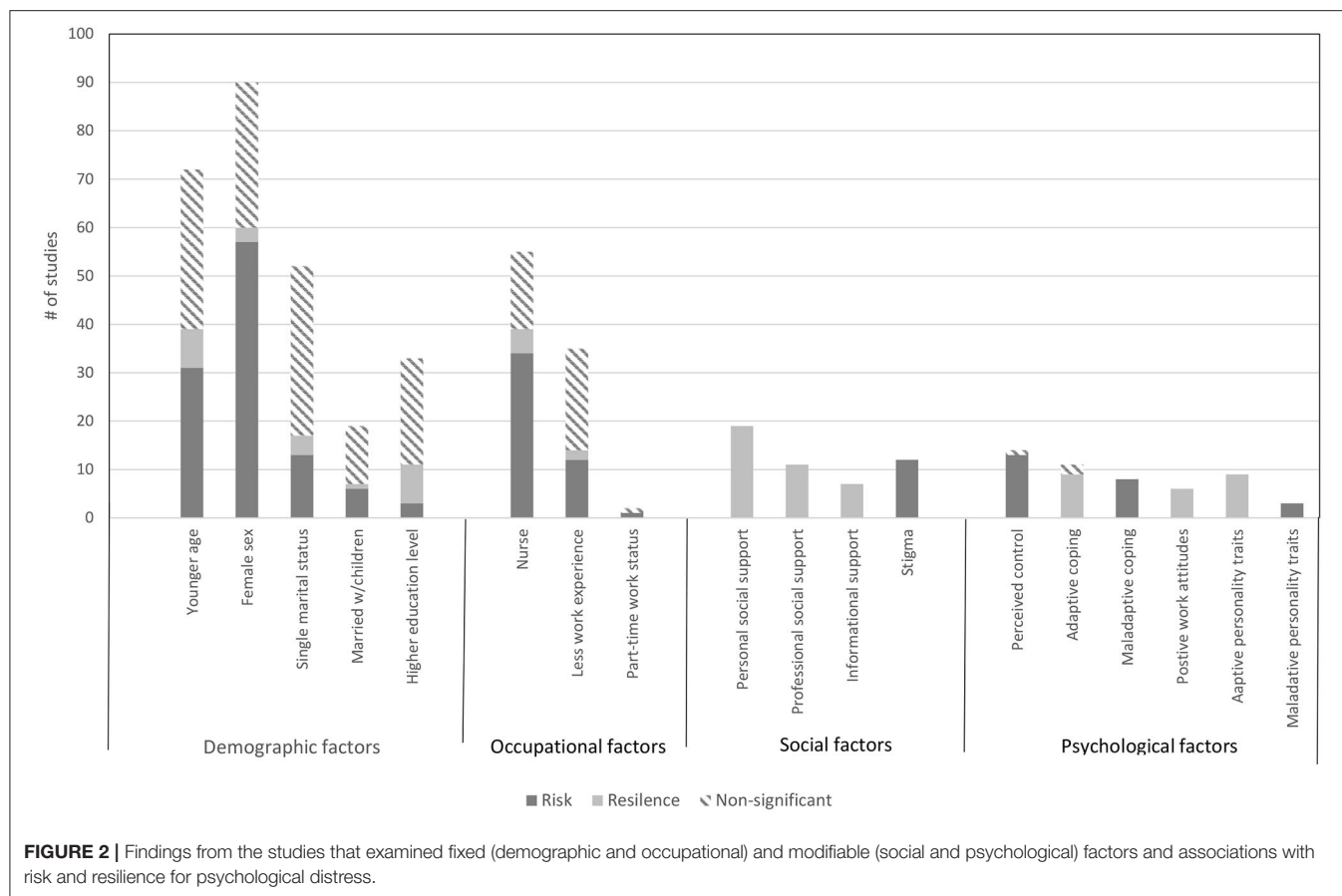
TABLE 2 | Continued

Factor	Evidence for risk	Evidence for resilience	Non-significant findings
Social support— professional/organizational		Ahmed et al. (24), Arafa et al. (28), Chan and Huak (41), Elbay et al. (54), Fiksenbaum et al. (59), Hong et al. (70), Jung et al. (79), Khattak et al. (80), Li et al. (88), Maraqa et al. (99), Rodriguez-Menéndez et al. (116)	
Adequate information		Chan and Huak (41), García-Fernández et al. (60), Goulia et al. (63), Maraqa et al. (99), Rodriguez-Menéndez et al. (116), Styra et al. (130), Vagni et al. (142)	
Stigma	Elhadi et al. (55), Goulia et al. (63), Juan et al. (78), Koh et al. (83), Master et al. (102), Maunder et al. (104), Maunder et al. (14), Park et al. (108), Park et al. (109), Rodriguez-Menéndez et al. (116), Teksin et al. (138), Verma et al. (144)		
Modifiable—Psychological			
Perceived control		Bettinsoli et al. (35), Fauzi et al. (58), Ho et al. (68), Hu et al. (72), Liao et al. (90), Marton et al. (101), Mo et al. (105), Shahrour and Dardas (123), Xiao et al. (10), Xiong et al. (150)	
Loss of control and perceived risk	Son et al. (126), Styra et al. (130), Wong et al. (148)		Hong et al. (70)
Adaptive coping styles and ability		Bettinsoli et al. (35), Chen et al. (47), Chen et al. (45), Fauzi et al. (58), Huffman et al. (74), Lin et al. (91), Master et al. (102), Vagni et al. (142), Wang et al. (145)	Babore et al. (31), Son et al. (126)
Maladaptive coping styles	Babore et al. (31), Chen et al. (47), Chen et al. (45), Lin et al. (91), Master et al. (102), Maunder et al. (14), Phua et al. (110), Wang et al. (145)		
Positive work attitudes		Babore et al. (31), Chan and Huak (41), Goulia et al. (63), Liu et al. (92), Tan et al. (135), Wang et al. (145)	
Adaptive personality traits		Cai et al. (38), Chen et al. (47), Dobson et al. (53), Hu et al. (72), Li et al. (89), Lin et al. (91), Mosheva et al. (106), Park et al. (108), Yörük and Güler (153)	
Maladaptive personality traits	Lu et al. (96), Maunder et al. (14), Yi-Ching et al. (96)		
Factors related to infection exposure			
Exposure to confirmed infected cases	Aksoy and Koçak (25), Alan et al. (27), Babore et al. (31), Badahdah et al. (32), Bettinsoli et al. (35), Chen et al. (47), Chen et al. (46), Chong et al. (13), Di Tella et al. (52), Erquicia et al. (57), Fiksenbaum et al. (59), Grace et al. (64), Giardino et al. (61), Guisti et al. (62), Han et al. (66), Hasan et al. (67), Holton et al. (69), Jain et al. (75), Juan et al. (78), Kim and Choi (81), Koh et al. (83), Lai et al. (84), Li et al. (87), Li et al. (89), Liu et al. (92), Liu		Bukhari et al. (37), Maraqa et al. (99), Maunder et al. (14), Sun et al. (132), Tselebis et al. (139), Veeraraghavan and Srinivasan (143), Xiong et al. (150)

(Continued)

TABLE 2 | Continued

Factor	Evidence for risk	Evidence for resilience	Non-significant findings
Increased risk of exposure to confirmed infected cases	Liu et al. (93), Liu et al. (95), Lu et al. (97), Magnavita et al. (98), Maraqa et al. (99), Maunder et al. (104), Mo et al. (105), Park et al. (109), Poon et al. (112), Rossi et al. (118), Stojanov et al. (129), Sun et al. (131), Surrati et al. (133), Tam et al. (134), Tang et al. (136), Teshome et al. (137), Verma et al. (144), Xing et al. (149), Yin et al. (152), Yörük and Güler (153)		Dobson et al. (53), Liu et al. (94), Sun et al. (132)
Colleagues being infected, quarantined, deceased	Bukhari et al. (37), Caillet et al. (40), Chatterjee et al. (42), Chen et al. (43), Chen et al. (45), Elbay et al. (54), Hu et al. (72), Lee et al. (85), Liao et al. (90), Liu et al. (95), Matsuishi et al. (103), McAlonan et al. (16), Pouralizadeh et al. (113), Ruiz-Fernández et al. (119), Sahin et al. (121), Saricam (122), Si et al. (125), Sorokin et al. (128), Styra et al. (130), Que et al. (115), Wang et al. (146), Yao et al. (151), Zhang et al. (155), Zhang et al. (156)		
Being in quarantine	Rossi et al. (118)		
Hospital resources, protection, training	Fiksenbaum et al. (59), Liu et al. (92), Maunder et al. (14), Sun et al. (132)	Chen et al. (44), Demirjian et al. (51), Elbay et al. (54), García-Fernández et al. (60), Gupta et al. (65), Hu et al. (72), Huffman et al. (74), Jain et al. (75), Kim and Choi (81), Maraqa et al. (99), Martínez-López et al. (100), Master et al. (102), Mosheva et al. (106), Pouralizadeh et al. (113), Surrati et al. (133), Tam et al. (134), Tang et al. (136), Sagaon-Teyssier et al. (120), Vagni et al. (142)	Juan et al. (78), Lee et al. (85), Park et al. (109), Si et al. (125), Zhang et al. (156)



outbreaks who perceived support from their supervisors and colleagues, experienced better mental health in the form of lower PTSD symptoms, lower distress, and being less likely to develop psychiatric symptoms, respectively (24, 28, 41, 54, 59, 70, 79, 80, 88, 99, 116).

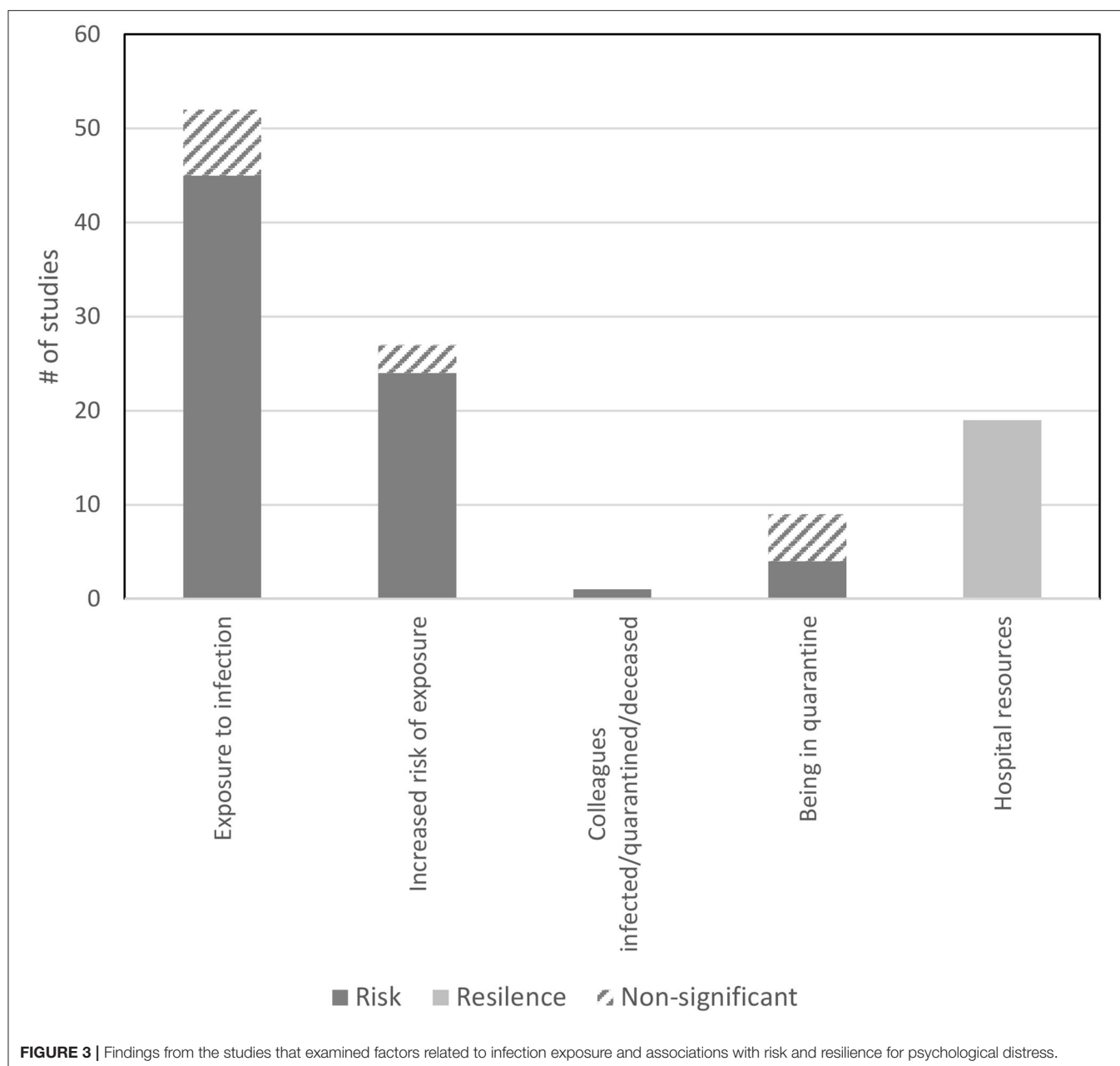
Seven studies examined receiving useful information from others (a common form of social support). In one study, HCW who received adequate communication and information about the H1N1 outbreak from their organization were less likely to experience psychiatric symptoms because it helped them cope better, and worry less about the pandemic (63). Similarly, HCW during the SARS outbreak who had confidence in the information they received from their organization (130), and who received clear communication about directives and how to take precautionary measures (41), experienced reduced psychological distress. HCW working during the COVID-19 outbreak who felt that they did not receive sufficient information, scored significantly higher on anxiety and acute stress than those who were satisfied with the information provided (60, 99, 116, 142).

Negative social perceptions created risk for poor mental health for HCW in all 12 studies that examined this factor. In nurses during the MERS outbreak, perceived social stigma was associated with higher stress and poorer mental health (108). Similarly, during the COVID-19 pandemic, HCW who

felt stigmatized, perceived stigma concerning negative public attitudes and disclosing about one's work, experienced higher levels of depression, anxiety, and psychological distress (55, 78, 102, 108, 109, 116, 138). During the SARS outbreak, HCW who felt people avoided their family because of their job were twice as likely to have elevated levels of post-traumatic stress symptoms (83). Importantly, experiencing stigma and avoidance from others was significantly associated with higher levels of post-traumatic stress symptoms during the SARS outbreak (104), and 13–26 months later (14).

Psychological Factors

The psychological factors examined in the studies included adaptive and maladaptive coping responses, beliefs and attitudes, and personality traits. Fourteen studies examined how perceptions of control were associated with distress among HCW (Table 2). In eight studies, higher self-efficacy was associated with lower anxiety, depression, distress, and lower levels of fear about SARS and post-traumatic stress symptoms during the COVID-19 and SARS outbreaks, respectively (10, 35, 68, 72, 90, 105, 123, 150). Conversely, feeling a loss of control was associated with greater distress (148) during the SARS outbreak in Hong Kong. Analogously, appraisals of personal risk were linked to higher levels of PTSD symptoms in HCW during the MERS (126) and SARS (130) outbreaks.



Only one study conducted with nurses during COVID-19 did not find evidence that risk appraisals were linked to greater distress (70).

Positive attitudes toward one's work were protective against distress in all six studies that examined this factor. Higher work satisfaction was associated with less psychological distress among hospital staff during the H1N1 outbreak (63), lower PTSD among nurses (145), and lower rates of burnout among HCW during the COVID-19 outbreak. Similarly, HCW during the SARS outbreak who felt their work had become more important were less likely to develop psychiatric symptoms (41), and those who viewed their work altruistically were less likely to have severe symptoms of depression 3 years later (92). HCW who held a positive attitude

toward their work reported less stress during the peak of the COVID-19 outbreak (31).

Seventeen studies examined whether coping styles were associated with HCW distress during an outbreak (Table 2). Emergency physicians and nurses working during the SARS outbreak who used denial, mental disengagement, or venting of emotions to cope were more likely to score higher on psychiatric morbidity (110). Similar results were found in frontline nurses during COVID-19, with use of negative coping associated with higher PTSD and psychological distress (102), and positive coping linked to lower PTSD (145). In HCW during the SARS outbreak, those who used maladaptive coping strategies, such as escape-avoidance, and self-blame coping, reported higher levels

of burnout, psychological distress, and post-traumatic stress when surveyed 13–26 months after the outbreak (14). However, the use of adaptive strategies, such as problem-solving and positive reappraisal, were not associated with any of the distress outcomes. This finding was consistent with those from studies in which coping ability was not significantly associated with PTSD symptoms during the MERS outbreak (126), and problem-solving and turning to religion to cope were not associated with reduced distress during COVID-19 (31).

Twelve studies investigated the role of personality in HCW's psychological distress (**Table 2**). During the SARS outbreak, neuroticism was linked to poorer mental health (96), and HCW who had an anxious attachment style reported experiencing higher burnout, psychological distress, and post-traumatic stress 13–26 months after the outbreak (14). Those with an avoidant attachment style reported greater distress, but not burnout or post-traumatic stress. Eight studies examined the role of dispositional resilience. Among nurses working during the MERS outbreak, higher levels of hardiness were associated with lower stress and better mental health (108), and resilience was associated with lower anxiety, depression, post-traumatic stress symptoms, and burnout among frontline nurses and HCW during COVID-19 (38, 45, 72, 74, 89, 91, 153).

Factors Related to Infection Exposure

Fifty-three studies examined the impact of direct contact with infected patients on HCW's psychological distress. Of these, the majority (65) found that being in direct contact with and/or treating patients infected with COVID-19, SARS, MERS, or H7N9 was a risk factor for psychological distress (**Table 2**). Only eight studies did not find that contact with infected patients increased risk for distress in HCW during the COVID-19, SARS, and MERS outbreaks. Similarly, 24 studies found that risk of contact with infected patients due to working in high-risk areas (e.g., ICU, isolation areas and infection units) was associated with higher levels of anxiety, stress, and post-traumatic stress symptoms than not working in such areas (**Table 2**). Notably, one study found that HCW in a high-risk unit during SARS reported higher and sustained perceived stress 1 year after the outbreak compared to those in low-risk units, with those in low-risk units reporting a decrease in stress over time, but those in high-risk units experiencing an increase in stress post-outbreak (16). Three studies conducted during COVID-19 found that risk of contact was not associated with greater distress (53, 94, 132). Spending time in quarantine due to risk of being infected was associated with higher levels of burnout, depression, and psychological distress in HCW during SARS and COVID-19 (14, 59, 92, 132), but was unrelated to post-traumatic stress symptoms and psychological distress in HCW during the MERS outbreak or the COVID-19 outbreak (78, 85, 109, 125, 156). Lastly, one study found that HCW who had colleagues who became infected, had deceased due to infection, or had been quarantined, also experienced higher levels of post-traumatic stress symptoms and acute stress during the COVID-19 outbreak (118).

Provision of adequate training, protection, and other resources to manage and reduce risk of infection was associated

with less psychological distress in all 19 studies that examined this factor (**Table 2**). Receiving clear infection control guidelines predicted lower psychological morbidity in frontline HCW during SARS (134), and having sufficient hospital resources for the treatment of MERS was associated with lower MERS-related burnout (81). After the implementation of a SARS protection training program, HCW experienced significant decreases in anxiety and depression 2 weeks and 1 month after the starting the program (44). Similarly, medical staff receiving inadequate training related to managing H7N9 had higher PTSD symptoms than those who received appropriate training (81). During COVID-19, HCW who felt that they did not have adequate information, training, personal protective equipment (PPE), felt unsafe, and perceived lower logistic support, reported higher levels of depression, anxiety, and acute stress symptoms (51, 54, 60, 65, 72, 74, 99, 100, 102, 106, 120, 142).

DISCUSSION

To our knowledge, this rapid systematic review of 139 samples of 143,246 HCW working during an infectious outbreak is the largest and most up to date review of the evidence on the factors that contribute to risk or resilience to psychological distress. In this review we introduced a conceptual framework that categorized the factors contributing to increased and reduced risk of psychological distress among HCW during an infectious disease outbreak into three main categories, including factors that were fixed, modifiable, and related to infection exposure. The majority of the studies reviewed examined the role of fixed factors (demographic and occupational), with fewer studies examining how modifiable factors (social and psychological) were associated with psychological distress in HCW working during an outbreak.

For the fixed factors, the weight of the evidence indicated that HCW who were female or a nurse were at significant risk for psychological distress (**Figure 2**). Nurses tend to be predominantly female, have higher workloads (104), and have more patient contact than other HCW. Indeed, we found that over 36 percent of the studies that found no significant relationship between being female and increased psychological distress involved only nurses.

There was also clear and consistent evidence that HCW who had or were at risk for contact with infected patients, were more likely to experience psychological distress (**Figure 3**). Worry about becoming infected is a key stressor for HCW in the context of an outbreak as risk of infection has implications not only for their own health but also for that of their families (83). Evidence also indicated that being in quarantine contributes to distress, perhaps due to being isolated from the team (158), and that vicariously experiencing these risks can be detrimental for HCW mental health (118).

Although relatively fewer studies investigated modifiable factors (**Figure 2**), the evidence highlighted key target areas to reduce HCW distress. It is also worth noting that the findings from the studies examining the role of social and psychological factors were extremely consistent. This lends confidence to the suggestion that these factors are important

targets for intervention to reduce distress and bolster resilience. Stigmatizing attitudes from the public toward HCW were consistently associated with greater distress across the studies reviewed. Although stigma can be effectively reduced through social contact with those who experience stigmatization (159), this approach may not be practical or advisable during an outbreak. Instead, public health campaigns that deliver accurate messages and highlight facts to reduce the fears underlying stigma (160), counteracting the climate of fear cultivated through the media which can promote stigma during an infectious outbreak (161) could assist.

The evidence was unanimous in indicating that perceiving social support was associated with lower distress. Adequate social support is a resilience factor that is well-known to be effective reducing stress across a number of stressful situations (162), and is equally important for reducing stress among HCW (163). This support can come from supervisors and co-workers (164), either formally or informally, through positive performance feedback (59), and positive attitudes, and through peer support groups. Organizational social support may be especially important to fill the gap when personal social support may be sparse because regular social support sources are struggling with their own distress during an outbreak. Such support can also foster positive work attitudes and satisfaction (165), which were associated with lower distress.

The evidence reviewed was also consistent in indicating that harmful coping strategies linked to greater distress, and positive coping strategies were protective for distress. Interventions that target harmful coping strategies, such as avoidance and self-blame, that can that may maintain or increase stress, may be worthwhile. Identifying when HCW may be using such strategies and finding ways to foster more positive approaches for managing stress are important for not only for reducing distress, but also for reducing the risk of other adverse health consequences. For example, HCW who experienced post-traumatic stress during the SARS outbreak and used harmful coping were at greater risk for substance abuse (166). Mental health check-ups are one approach that could help monitor both HCW distress and whether appropriate coping strategies are being used (167).

In keeping with evidence that low perceived control is a transdiagnostic vulnerability factor for anxiety (168), perceptions of control were consistently associated with lower distress in the evidence reviewed. Indeed, having a sense of control is a well-known factor for reducing health-related distress (162). Feeling a loss of control may be inevitable during an infectious outbreak, as perceptions of risk are inversely related to perceived control (169). However, interventions focused on increasing a sense of autonomy can be effective for reducing distress in HCW during times of upheaval (170). The evidence reviewed suggests that this might be accomplished at the organizational level by providing HCW with the resources needed to manage the risk of infection. For example, providing personal protective equipment (PPE), adequate training, and clear guidelines, information, and protocols for infection control are important, because having such resources is linked to lower distress. This conclusion is consistent with research that found that access to

information and provision of needed resources increased a sense of empowerment among ICU nurses (171).

Adaptive personality traits consistently linked to better mental health outcomes in HCW working during an outbreak. Dispositional resilience was examined in the majority of the studies reviewed, with hardiness examined in one study. Dispositional resilience can be conceptualized in several different ways, including as a personal quality reflecting the capacity to cope, or as type of hardiness (172). When conceptualized as the former, resilience involves being flexible to change, managing unpleasant emotions, and not getting discouraged (173). Although personality traits are often viewed as being relatively stable, personality can also be viewed as reflecting personal qualities and tendencies that are expressed to a greater or lesser degree, and are therefore amenable to change (174). From this perspective, approaches that help HCW develop a tendency to use resilient coping skills may help reduce vulnerability to psychological distress during an outbreak.

Limitations and Strengths

There are several limitations of this rapid systematic review. Conducting the review during the ongoing outbreak of COVID-19 imposed time constraints. This meant that we only included published peer-reviewed literature and did not search more thoroughly through gray literature or online pre-print repositories. Most study samples were quite large, increasing confidence in the generalisability of the findings.

In terms of the evidence base, the majority of the studies were cross-sectional, providing only a snapshot of the factors associated with HCW psychological distress. This limits conclusions about the direction of causality between the factors and distress, especially for those factors that are modifiable. Only three studies examined the potential long-term effects of the risk and resilience factors on HCW's mental health by using follow-up and time-lagged designs (14, 16, 92), providing some support for the assumed contribution of the factors to distress. More research needs to track the associations of risk/resilience factors over time with distress and the extent to which certain factors link to sustained or transient distress.

The majority of the studies were conducted during COVID-19, with relatively fewer studies reporting results from other infectious outbreaks such as SARS, MERS, H1N1, H7N9, and Ebola. On the one hand, this could be viewed as a limitation on the generalisability of the findings from the predominant outbreak, COVID-19, to other infectious outbreaks. On the other hand, we would argue that the consistency of the findings for a number of factors including participant sex, being a nurse, all 10 of the social and psychological factors, four of the five infection exposure factors, demonstrate that findings are likely to be generalizable across infectious outbreaks for these factors.

Although a number of studies investigated fixed factors and infection-related factors, relatively fewer studies examined how modifiable factors linked to distress (**Figures 2, 3**). There is a need for more research focusing on these factors to

provide a more solid evidence base about potential targets for clinical intervention and treatment. A handful of studies used unvalidated measures of psychological distress, raising concerns about whether the findings would be the same had validated measures been used. For those studies that used validated measures, the ways in which cut-off scores for caseness were calculated, and/or the ways in which classification of symptoms met thresholds for psychological distress, undoubtedly varied between measurement instruments. This likely introduced some variance into the results.

Few studies considered potential confounders in the associations with distress, compared found associations in matched non-HCW samples, or the extent to which the factors were predictive of distress outside of an outbreak. As well, the results extracted from the studies reflect a mix of bivariate and multivariate associations, as not all studies reported the bivariate only findings, which would be more comparable for making comparisons. Studies that examined the factors in multivariate analyses often used different covariates making it difficult to draw equitable conclusions from the studies. It is therefore difficult to assess the degree to which certain factors may independently predict psychological distress over and above other factors. Collectively, these limitations may have contributed to the equivocal findings noted for several of the factors reviewed.

Several strengths of the Review balance these limitations. Conceptually organizing the factors according to risk or resilience and whether they were fixed or modifiable, provided a theoretical framework for identifying who might be at most risk for psychological distress. This facilitates appropriate clinical intervention, and for noting which factors would be suitable targets for potential interventions. We also reported non-significant and contrary findings alongside significant findings to provide a more balanced and critical overview of the evidence. The Review included evidence from across six infectious disease outbreaks, with the majority of the research reporting findings from coronavirus outbreaks—Severe Acute Respiratory Syndrome Coronavirus-2 (COVID-19), Severe Acute Respiratory Syndrome-related coronavirus (SARS), and Middle East Respiratory Syndrome-related coronavirus (MERS)—that share similarities in their symptom and contagion profiles. Consistent evidence for risk and resilience factors was found across these various infectious diseases, suggesting that the findings from this review may be applicable across different outbreaks. This is relevant for understanding the mental health of HCW in future outbreaks. Lastly, conducting a series of search updates ensured integration of the most recent evidence from the ongoing COVID-19 outbreak into the review at the time of submission.

Implications and Conclusions

Whereas, other reviews have documented the extent of distress experienced by HCW during an outbreak (2), the current Review highlights the profiles of HCW most at risk for psychological distress and psychiatric morbidity during an outbreak. This

identified modifiable factors that warrant further investigation as possible points of intervention to mitigate distress. Viewing risk and resilience factors from the lens of fixed and modifiable factors provides an efficient and useful approach for understanding who is most at risk and how to address that risk during and after an outbreak. Further research focusing on possible interactions among these factors would be useful to gain a better understanding of both the risk profiles and key modifiable factors, as the evidence reviewed did not consistently examine this area.

There is evidence that the psychological distress from working during an outbreak can persist for 2–3 years after the outbreak (14–16). Therefore, monitoring and providing appropriate support should continue beyond the outbreak period to ensure mental health recovery, especially among HCW who are most at risk. Our findings suggest that particular attention should be paid to female HCW and nurses (regardless of sex), and those who come into contact with infected patients or their environments to ensure that they receive necessary resources and provision of support to manage psychological distress. Proactive approaches at the organizational level can be effective (164) and may be necessary to help reduce the psychological distress of HCW. For example, a study of HCW during the COVID-19 outbreak in China found that mental health resources and services were mainly used by those experiencing mild and subthreshold levels of psychological distress rather than those who experienced more severe distress (11). Addressing the mental health needs of HCW with more severe distress will likely require more proactive means from health-care organizations.

There are a number of delivery methods to provide support and help HCW modify risk factors and foster resilience factors. These include telehealth, mobile apps, online toolkits, and peer-support, either in person or virtual (175). Combining different approaches may also be effective. For example, social support and perceived control can have an additive effect for reducing stress related to job demands (176). There is also evidence for the effectiveness of interventions for reducing HCW distress when delivered at the person level and organizational level (164), as well as those that target lifestyle practices (177, 178).

Evidence from randomized controlled trials suggests that third-wave cognitive behavioral therapeutic approaches, such as mindfulness (178), gratitude (177), and self-compassion (179), are effective for reducing stress and burnout among healthcare professionals, and could be beneficial. In low-resource settings, peer-support is one option that has been shown to be effective for reducing occupational distress in HCW (164). Raising awareness of the impact of an infectious outbreak on HCW mental health, providing appropriate treatment and therapy, and fostering proactive approaches such as an organizational culture of support (180), are recommended as possible approaches that can help prepare HCW for future outbreaks and address any persistent, long-term distress following the outbreak.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

FS and JO designed and conceived the study, searched for evidence, screened and analyzed the data, drafted the work, revised it critically for intellectual content, approved the final piece of work for publication, and agree to be accountable for

the work. All authors contributed to the article and approved the submitted version.

ACKNOWLEDGMENTS

An earlier version of this manuscript has been released as a pre-print at medRxiv (181).

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2020.589545/full#supplementary-material>

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The Relationship Between Mental Toughness, Job Loss, and Mental Health Issues During the COVID-19 Pandemic

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OPEN ACCESS

Edited by:

Carlo Lai,
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San Martino Hospital (IRCCS), Italy

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 16 September 2020

Accepted: 31 December 2020

Published: 03 February 2021

Citation:

Mojtahedi D, Dagnall N, Denovan A, Clough P, Hull S, Canning D, Lilley C and Papageorgiou KA (2021) The Relationship Between Mental Toughness, Job Loss, and Mental Health Issues During the COVID-19 Pandemic.
Front. Psychiatry 11:607246.
doi: 10.3389/fpsy.2020.607246

Concerns toward public well-being and mental health are increasing considering the COVID-19 pandemic's global societal and individual impact. The present study builds on the current body of COVID-19 literature by examining the role of mental toughness (MT) in predicting negative affective states (depression, anxiety and stress) during the pandemic. The study also examined the effects of changes in employment on mental health and MT. Participants ($N = 723$) completed a battery of questionnaires including the *Mental Toughness Questionnaire 48-item*, *The State-Trait Anxiety Inventory*, and the *Depression, Anxiety and Stress Scale – 21 items*. Participants reported relatively higher levels of depression, stress and anxiety in comparison to pre-COVID-19 samples from previous research, with respondents who had lost their jobs during the pandemic reporting higher levels of negative affective states. Despite this, mentally tough individuals appeared to report lower levels of depression, anxiety and stress. Moreover, moderation analyses identified some interaction between MT and employment status when predicting depression, anxiety and stress. Our findings suggest that MT may have some utility in reducing the adverse mental health effects of the pandemic on individuals, however, further longitudinal research is needed to support these implications.

Keywords: COVID-19, mental health, mental toughness, unemployment (effects of), anxiety, depression, stress

INTRODUCTION

The COVID-19 pandemic has heightened concerns about public well-being and mental health (1). Correspondingly, there has been a rapid growth in research assessing the consequences of the coronavirus on psychological well-being. Since the effects are complex, evolving and ongoing, continuous research is required to explore the extent of the problem, and to identify potential protective factors. Acknowledging these points, the present study examined whether level of mental toughness (MT) predicted mental health outcomes during the pandemic and assessed whether high levels of MT moderated (reduced) the potential negative psychological effects of the COVID-19 pandemic. This included consideration of the consequences of occupational instability (i.e., job insecurity and loss), which research has identified as a major source of both social and individual concern [e.g., (2)].

Rajkumar (3), undertook a review of extant literature on COVID-19 and mental health. This revealed that symptoms of anxiety and depression (16–28%) and self-reported stress (8%) were common psychological reactions to the pandemic. Studies within the review noted also that stress and anxiety were frequently attendant with disturbed sleep quality (4, 5). Rajkumar (3) observed also that individual (e.g., mental health and age) and structural variables (e.g., support services) mediated and moderated risk. Pre-COVID literature identify further risk factors (e.g., negative affective temperaments & pre-existing depression) that could aggravate the negative psychiatric states experienced [e.g., feelings of hopelessness and increased suicide risk, (6, 7)]. Illustratively, due to the stress associated with the COVID-19 outbreak, patients with pre-existing mental disorders were susceptible to relapse or new episodes resulting from their disorder (8).

The general finding that self-reported anxiety, depression, and stress are common psychological reactions to the COVID-19 pandemic aligns with previous related work that has observed that psychological distress and symptoms of mental illness are associated with outbreaks of infectious disease (9, 10). In the context of COVID-19, resultant social and behavioral changes such as disrupted travel plans, social isolation, media information overload, and widespread panic buying of necessity goods, heightened the increasing menace of the epidemic. Collectively, these factors contributed to concern regarding the COVID-19 situation and helped to create a global atmosphere of concern and despair (9, 11).

An important feature of Rajkumar (3) review of COVID-19 and mental health was that it noted that individual and structural variables influenced the risk of negative psychological consequences. In this context, a key factor is occupational security (2). Indeed, studies have noted that loss of employment and fear of unemployment are major concerns that contribute to negative affective states during the pandemic (12, 13). Relatedly, for many the pandemic has resulted in permanent or temporary (furlough) job loss, which have been previously linked with symptoms of depression (14). Despite global government attempts to relieve financial distress through increasing welfare support, Mimoun et al. (2) found that even those who were temporarily furloughed during the COVID-19 pandemic reported higher levels of distress than those who were unemployed prior to the pandemic. The authors explained that jobs “provide individuals a sense of confidence, self-esteem, and control” [(2, p. 184)].

Consideration of COVID-19-related literature supports the notion of individual differences in susceptibility to the pandemic’s mental health impact. Wang et al. (15) surveyed the general public in China to better understand psychological impact (i.e., anxiety, depression, and stress) during the initial outbreak. They found that gender (i.e., female), student status, specific physical symptoms (e.g., myalgia, dizziness, coryza), and poor self-rated health status were significantly associated with greater psychological impact [i.e., higher levels of stress, anxiety, and depression as measured by the Depression Anxiety and Stress Scales, DASS21; (16)]. In a subsequent study, Wang et al. (17) conducted a longitudinal study covering the initial outbreak

(Jan 31) and the peak of the epidemic 4 weeks later. During the preliminary evaluation, moderate-to-severe stress (8.1%), anxiety (28.8%) and depression (16.5%) were experienced by a noticeable minority of the group. Additionally, while the number of confirmed cases of COVID-19 increased markedly from the first to second survey, no significant changes occurred for DASS21 scores. Proposed protective factors included greater confidence in doctors, perceived survival likelihood and low risk of contracting COVID-19, satisfaction with health information, and personal precautionary measures.

From these studies it is clear that individual differences can play a significant role in mitigating the negative mental effects of the pandemic (15, 17, 18). Although adversity and challenge are natural consequences of everyday existence, susceptibility to the adverse consequences of accompanying anxiety, depression and stress can prove detrimental to mental health, well-being and everyday functioning (i.e., social, educational, occupational functioning & suicide ideation) (6, 19). Thus, with regards to the COVID-19 pandemic, it is important to identify and understand psychological factors that protect against potential commensurate anxiety, depression and stress. One widely researched positive psychological construct that has been associated with beneficial outcomes across a range of settings (e.g., educational, occupational and sport) is mental toughness (MT).

The concept of MT is highly relevant to the COVID-19 pandemic because it provides a conceptual framework for understanding individual differences in resilience and reactivity to negative impacts. At a general level, MT serves as an umbrella term to denote enabling psychological resources across a range of achievement contexts that promote positive mental health (20–22). The concept was initially employed within the domain of sport psychology to denote a battery of experientially developed and heritable psychological resources (i.e., values, attitudes, emotions, cognitions, and behaviors) that facilitated success in sports and physical activity (23). However, since its emergence, MT has been employed within clinical, developmental and occupational contexts, demonstrating similar enabling effects on achievement and positive mental health (24–32).

There are various conceptualisations of MT [e.g., (33, 34)]. The most widely cited and generally applied model was proposed by Clough and colleagues. Clough et al. (35) characterized MT as a composite of four interrelated, but independent components: [1] *Control* (life and emotion): the tendency to feel and act as if one is influential and keep anxieties in check; [2] *Commitment*: the tendency to be deeply involved in pursuing goals despite difficulties that arise; [3] *Challenge*: the tendency to see potential threats as opportunities for self-development and to continue to strive in changing environments; and [4] *Confidence* (in abilities and interpersonal): the belief that one is a truly worthwhile person in spite of setbacks, and the ability to push oneself forward in social settings.

Commensurate with previous work, the authors postulated that high levels of MT would attenuate the adverse psychological effects of the COVID-19 pandemic. This rationale derived from innumerable studies evidencing that individuals with higher levels of MT adapt better to stressful situations (36–38).

For example, in a longitudinal study, Gerber et al. (37) explored the relationships between MT, psychological stress, depressive symptoms, and life satisfaction. Both perceived stress and depressive symptoms correlated negatively with MT. Moreover, MT was positively associated with life satisfaction. The researchers also found that well-adjusted individuals (low levels of stress, few depressive symptoms, and high life satisfaction) scored high on MT, whereas maladjusted individuals (high levels of stress, depressive symptoms, and little life satisfaction) tended to have lower levels of MT. Interestingly, resilient (moderate levels of stress at baseline, decreased depressive symptoms and increased life satisfaction at follow-up) and deteriorated (increasing levels of stress, increasing depressive symptoms, and decreasing life satisfaction) individuals did not differ at baseline but showed an increase/decline of MT over time (resilient and deteriorating individuals, respectively).

Consistent with these findings, Gerber et al. (37) showed that MT was associated with lower perceived stress and fewer depressive symptoms in a sample of 284 high school students and in a sample of 140 undergraduate students. They also showed that MT moderates the relationship between high perceived stress and depressive symptoms. More specifically, high levels of MT were associated with lower depressive symptoms, when perceived stress levels were high.

Present Study

Research on the mental health implications of the COVID-19 pandemic is rapidly growing. However, relatively little academic work has attempted to identify dispositional protective factors against negative affective state during the pandemic (39). Previous research has identified a clear link between MT and resilience to stress, however, prior to this paper the relationship had not been explored in the context of the COVID-19 pandemic – a period of global and societal distress. Accordingly, the present study examined the relationship between MT and self-reported levels of depression, anxiety, and stress. Past research suggests that mentally tough individuals are less prone to experiencing negative emotions when placed in stressful situations (37, 38). Emanating from this, the current authors contend that mentally tough individuals should therefore be less susceptible to negative affective states during lockdown. More specifically, three hypotheses have been formulated: Hypothesis one predicts that MT traits will be negatively correlated with depression (DASS21); Hypothesis two predicts that MT traits will be negatively correlated with anxiety (DASS21 & STAI-Y1); and Hypothesis three predicts that MT traits will be negatively correlated with stress (DASS21).

Clough et al. (35) define MT as a stable, narrow, personality trait. This supposition is supported by consistent evidence of a genetic underpinning [e.g., (40–42)]. However, they recognize also that MT is modified by environmental factors, [e.g., training, (43); and positive youth experiences (44)]. Thus, it is possible that sustained and pervasive stressors may affect toughness scores. One objective stressor is job loss. Losing one's job often has a negative effect on well-being (14). Uniquely, in the current pandemic there are four options: retaining the job, furlough, job loss and previously unemployed. Thus, the second aim

of the study was to examine whether employment status had an effect on MT scores and negative affective state. Due to a lack of research exploring the stability of MT, no predictions were made on the relationship between employment status and MT. However, the effects of job loss on mental health have been observed within past research [see (2, 14)]. Based on these findings, the following additional hypotheses are presented: Hypothesis four predicts that respondents who had lost their jobs during the pandemic will report higher level depression (DASS21) than those in employment; Hypothesis five predicts that respondents who had lost their jobs during the pandemic will report higher level anxiety (DASS21 & STAI-Y1) than those in employment; and Hypothesis six predicts that respondents who had lost their jobs during the pandemic will report higher levels of stress (DASS21) than those in employment.

The present study is the first to examine the role of MT during the COVID-19 pandemic and does so using a large diverse sample (internationally and temporally, see below) to produce representative results. The research will allow us to determine whether such traits can mitigate mental health problems during the pandemic. Moreover, the practical implications of the findings can inform future strategies for protecting public mental health during current and future pandemics.

MATERIALS AND METHODS

Samples and Design

This study was cross-sectional in nature. The cross-sectional approach is frequently criticized because it is inclined to common method variance (CMV) (45). This occurs when variations in responses reflect measurement procedure rather than underlying differences in the observed construct(s). To counter CMV, the researchers employed procedural remedies (46). Firstly, instructions created psychological distance between scales by emphasizing that each measure assessed a separate construct. Encouraging respondents to perceive scales as distinct has previously successfully reduced common method variance (47). Secondly, the instructions attempted to negate social desirability effects and evaluation apprehension by stating that there were no correct answers. Published studies have previously successfully implemented these procedural remedies [e.g., (48, 49)].

The study used self-report measures hosted online via Qualtrics. Data collection occurred at two different time-points on independent samples to determine whether the association between MT and negative states could be replicated. The inclusion criteria required all participants to be aged 18 or above and speak English proficiently. The combined dataset consisted of 723 participants (male = 315, female = 407, and other = 1), aged between 18 and 78 ($M = 35.06$, $SD = 13.65$). The demographic details of both samples are presented in **Table 1**. The first sample (Sample A) consisted of 376 participants (male = 95, female = 280, other = 1) aged between 18 and 78 ($M = 34.10$, $SD = 14.34$) from the UK and Ireland. Data collection was carried out between April 23rd and May 21st, with most responses (76.33%) collected between April 23rd and April 30th, 2020. The survey was advertised through social media and online

TABLE 1 | Demographic variables for samples.

	Sample A (<i>n</i> = 376)	Sample B (<i>n</i> = 347)	Total (<i>N</i> = 723)
Age (<i>M</i> , <i>sd</i>)	34.1 (14.34)	36.09 (12.79)	35.06 (13.65)
Gender			
Male	95 (25.3%)	220 (63.4%)	315 (43.6%)
Female	280 (74.5%)	127 (36.6%)	407 (56.3%)
Other	1 (0.3%)	0	1 (0.1%)
Employment			
Job loss	14 (3.9%)	50 (14.4%)	64 (9.1%)
Furloughed	75 (21%)	31 (8.9%)	106 (15.1%)
Previously unemployed	63 (17.6)	46 (13.3%)	109 (15.5%)
Working (traveling)	80 (22.4%)	66 (19%)	146 (20.7%)
Working (home)	125 (35%)	154 (44%)	279 (36.9%)

internet groups. Participants from Sample A were not financially compensated for their involvement.

Data for the second sample (Sample B) were collected on May 18th and May 25th, 2020, with the majority (97.4%) of responses collected on May 25th. For Sample B, the authors recruited participants via an online crowd sourcing marketplace, Amazon Mechanical Turk (*Mturk*). Each respondent was rewarded \$0.30 for their involvement. Previous research indicates that data collected through *Mturk* are of high quality (50). Additionally, measures were taken to ensure that respondents were reading and responding to the questions logically (as opposed to haphazardly providing responses to receive the reward).

Three validity-test questions were placed within the survey instructing participants to select a specific response (e.g., “for this question please select the number 4”). In total 415 participants were recruited. However, 68 cases were omitted from the study after failing to correctly answer the validity-test questions, leaving a final sample of 347 participants (male = 220, female = 127) aged between 18 and 76 (*M* = 36.09, *SD* = 12.79). In order to allow for cultural comparisons to be made between the two samples, the authors used *Mturk*'s preference filter to make the Sample B survey only available to non-UK participants, however, 17 participants from the UK still managed to complete the survey and were included in the final sample. The other participants from Sample B were from North America (*n* = 239), India (*n* = 60), and Brazil (*n* = 18) and other (*n* = 13).

The survey asked questions pertaining to the participants' (i) demographic information (including job status), (ii) negative affective states during the pandemic (i.e., anxiety, depression, and stress), and (iii) mental toughness. The survey also contained some additional questions about the participants' general well-being and attitudes toward COVID-19, however these items were not of interest to the present study and thus, they are not discussed further. The average completion time was 21 min for respondents in Sample A and 15 min for respondents in Sample B.

Measures

Respondents provided information about their age, gender, country of residence and job status during the pandemic. For

job status, participants were asked to select the most appropriate response from the following options: *Unemployed before the pandemic, I lost my job/business during the pandemic, furloughed, I still have my job/business and travel to work, I still have my job/business and working from home (WFH)*.

Depression, Anxiety, and Stress Scale [DASS21; (51)] is a 21-item self-report instrument that measures symptoms of depression, anxiety and stress at the time of participation. Each item is presented as a statement that the participant rates their agreement to using a four-point Likert scale (0 = Did not apply to me at all, 3 = Applied to me very much or most of the time). The scores for each subscale are calculated by multiplying the sum of the respective items by two. DASS21 was identified as a suitable measure for the present study due to demonstrating high internal consistency across clinical and non-clinical samples (52–54). High Cronbach's alphas were observed within the present study for Sample A (Stress = 0.9, Anxiety = 0.82, Depression = 0.91) and B (Stress = 0.91, Anxiety = 0.92, and Depression = 0.92).

Spielberger State-Trait Anxiety Inventory [STAI; (55)] measures trait (baseline) and state (situational) anxiety, through two 20-item scales. The items describe different affective states and participants are required to indicate how much each statement reflects their mood either at the time of survey completion (STAI-Y1) or in general (STAI-Y2) using a four-point Likert scale (1 = almost never/not at all, 4 = almost always/very much so). Research studies [e.g., (56, 57)] have continuously supported the construct validity of both subscales. High Cronbach's alphas were also observed within the present study within Sample A (STAI-Y1 = 0.96; STAI-Y2 = 0.94) and B (STAI-Y1 = 0.91; STAI-Y2 = 0.92).

The *Mental Toughness Questionnaire 48* [MTQ48; (35)] measures MT through four components: Control (14 items), Confidence (15 items), Commitment (11 items) and Challenge (8 items). Participants are required to indicate their level of agreement using a five-point Likert scale (1 = strongly disagree; 5 = strongly agree). Each component is scored by calculating the mean of the respective items with higher scores indicating a greater level of MT. The MTQ-48 has established internal and test-retest reliability (36, 37, 40, 58, 59). Furthermore, Clough et al. (35) provide evidence for MTQ-48 construct validity via significant relationships with related measures (i.e., optimism, self-image, satisfaction with life, self-efficacy, and trait anxiety). High Cronbach's alphas were also observed within the present study within Sample A (Challenge = 0.82; Commitment = 0.86; Control = 0.77; and Confidence = 0.88) and B (Challenge = 0.67; Commitment = 0.79; Control = 0.68; and Confidence = 0.78).

Statistical Analysis

All statistical analyses were performed using SPSS® 26.0 (IBM Corporation, Armonk NY, USA) for Windows®/Apple Mac®. For all regression models, preliminary analyses were conducted to ensure no violation of the assumptions of linearity, and homoscedasticity. The collinearity statistics (VIF & Tolerance) for all models indicated that multicollinearity was unlikely to be a problem [see (60)]. All predictor variables were statistically correlated with the outcome variables which indicates that the

TABLE 2 | Scale averages.

	Sample A (n = 372)		Sample B (n = 347)		Statistics
	<i>m</i>	<i>sd</i>	<i>m</i>	<i>sd</i>	
State anxiety	43.58	12.89	45.55	10.86	$p = 0.03$ [$t(686.67) = -2.2$, 95% CI = -3.74 to -0.21 , $\eta^2 = 0.007$] ^t
Trait anxiety	42.7	12.19	44.36	10.95	$p = 0.06$ [$t(702.79) = -1.92$, 95% CI = -3.38 to 0.04 , $\eta^2 = 0.005$] ^t
Stress	13.32	10.05	17.48	11.02	$p > 0.001$ [$U = 49,741.5$, $Z = -5.22$, $r = -0.19$] ^m
Anxiety	7.01	7.78	15.20	11.71	$p > 0.001$ [$U = 39,863$, $Z = -8.9$, $r = -0.33$] ^m
Depression	10.99	9.9	16.32	11.35	$p > 0.001$ [$U = 47,354.5$, $Z = -6.14$, $r = -0.23$] ^m
Challenge	3.47	0.62	3.41	0.54	$p = 0.18$ [$t(713.98) = 1.35$, 95% CI = -0.03 to 0.14 , $\eta^2 = 0.002$] ^t
Commitment	3.46	0.64	3.32	0.61	$p = 0.002$ [$t(717) = 3.13$, 95% CI = 0.05 to 0.24 , $\eta^2 = 0.01$] ^t
Control	3.14	0.53	3.08	0.45	$p = 0.39$ [$t(714.09) = 0.86$, 95% CI = -0.04 to 0.1 , $\eta^2 = 0.001$] ^t
Confidence	3.25	0.65	3.29	0.5	$p = 0.35$ [$t(702.21) = -0.94$, 95% CI = -0.13 to 0.04 , $\eta^2 = 0.001$] ^t

corrected alpha = 0.005; ^t = *t*-test (two-tailed), ^m = Mann-Whitney *U*.

TABLE 3 | Correlations between continuous variables.

	Sample A									Sample B								
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
1. State anxiety	1	0.74	0.79	0.66	0.72	-0.49	-0.43	-0.61	-0.57	1	0.77	0.6	0.47	0.6	-0.52	-0.57	-0.65	-0.63
2. Trait anxiety		1	0.64	0.63	0.71	-0.6	-0.62	-0.74	-0.77		1	0.75	0.64	0.77	-0.57	-0.73	-0.77	-0.74
3. Stress (dass)			1	0.72	0.72	-0.4	-0.4	-0.55	-0.48			1	0.87	0.89	-0.31	-0.63	-0.62	-0.49
4. Anxiety (Dass)				1	0.68	-0.44	-0.42	-0.56	-0.51				1	0.85	-0.25	-0.59	-0.57	-0.4
5. Depression (Dass)					1	-0.46	-0.51	-0.57	-0.61					1	-0.33	-0.69	-0.67	-0.54
6. Challenge (MT)						1	0.63	0.67	0.7						1	0.61	0.61	0.72
7. Commitment (MT)							1	0.66	0.67							1	0.76	0.74
8. Control (MT)								1	0.77								1	0.76
9. Confidence (MT)									1									1

All relationships were statistically significant ($p < 0.001$).

data was suitably correlated with the dependent variables for examination through multiple linear regression to be reliably undertaken. All measures of effect size were interpreted in accordance with Cohen (61).

RESULTS

Depression, Anxiety, and Stress During the COVID-19 Pandemic

Preliminary observations were conducted to test the normality assumptions of the dependent variables. Observations of the histograms indicated that the DASS21 variables (depression, anxiety, and stress) were not normally distributed. As a result, between-group comparisons of DASS21 scores were conducted using non-parametric tests. Following this, a series of *t*-tests and Mann-Whitney *U*-tests were conducted to compare the two samples in mental toughness and affective states (see Table 2). Bonferroni corrections were applied (corrected to $p = 0.005$).

There were no significant differences between the two samples in state anxiety and trait anxiety at the corrected alpha. In relation to the DASS21 variables (depression, anxiety, and stress), preliminary observations indicated that the data was not

normally distributed, therefore Mann-Whitney *U* tests were used to compare the samples. For stress, 27.5% of Sample A reported moderate to extremely severe levels of stress compared to 47.8% of Sample B [see (51) for label scoring]. Differences in stress scores were found to be statistically significant, but small. For anxiety, 31% of Sample A reported moderate to extremely severe levels of anxiety compared to 63.7% of Sample B. Differences in anxiety scores were also significant, but small. For depression, 33.1% of Sample A reported moderate to extremely severe levels of depression compared to 62.6% of Sample B. Differences in depression scores were also significant, but small. In relation to MT, differences in Commitment reached statistical significance, however, the eta squared statistic indicated a small effect size (see Table 2). No significant differences were found for Challenge, Control, and Confidence.

Mental Toughness and Negative Affective States

A series of hierarchical multiple regressions (HMR) were performed to investigate the ability of MT traits (Challenge, Commitment, Control, & Confidence) to predict depression, anxiety and stress. To reduce the effects of individual differences

in baseline negative affectivity, a hierarchical model was used to control for trait anxiety (STAI-Y2). In the first step of HMR, four predictors were entered: Challenge, Commitment, Control, & Confidence; the second step then introduced trait anxiety to the model. Due to the sample comparisons identifying significant differences in depression, anxiety and stress, the association between MT traits and negative affective states were assessed for each sample individually. The correlations between all continuous variables are presented in **Table 3**. The table suggests that the correlations between the variables were relatively similar across both samples. The correlations between MT traits and negative affective states were small to large ($r = -0.31$ to -0.77). All predictor variables were statistically correlated with depression, anxiety (DASS21 and STAI-Y1) and stress, which indicates that the data was suitably correlated with the dependent variables for examination through multiple linear regression. The HMR model properties for Sample A and B are presented in **Tables 4, 5**, respectively.

Stress

A HMR model was used to predict stress within Sample A. In the first step of hierarchical multiple regression, the model was statistically significant $F_{(4,350)} = 39.6$; $p < 0.001$ and explained 31.2% of variance in state stress. Control made a significant unique contribution to the model (see **Table 4**). After entry of trait anxiety at Step 2 the total variance explained by the model as a whole was 42.1% [$F_{(5,349)} = 52.57$; $p < 0.001$]. The introduction of trait anxiety explained an additional 11.8% of variance in state stress, after controlling for the mental toughness traits [$F_{(1,349)} = 72.2$; $p < 0.001$]. In the final adjusted model, trait anxiety and Control were statistically significant.

For Sample B, in the first step, the model was statistically significant $F_{(4,342)} = 76.53$; $p < 0.001$ and explained 47.2% of variance in state stress. Three predictors made a significant unique contribution to the model (see **Table 5**). After entry of trait anxiety at Step 2 the total variance explained by the model as a whole was 62.7% [$F_{(5,341)} = 114.64$; $p < 0.001$]. The introduction of trait anxiety explained an additional 15.5% of variance in state stress, after controlling for the mental toughness traits [$F_{(1,341)} = 141.4$; $p < 0.001$]. In the final adjusted model, all five predictor variables were statistically significant.

Depression

A HMR was next used to predict depression within Sample A. In the first step, the model was statistically significant $F_{(4,351)} = 60.53$; $p < 0.001$ and explained 41% of variance in state depression. Three of the four mental toughness traits made a significant unique contribution to the model (see **Table 4**). After entry of trait anxiety at Step 2 the total variance explained by the model as a whole was 52% [$F_{(5,350)} = 60.46$; $p < 0.001$]. The introduction of trait anxiety explained an additional 11% of variance in state depression, after controlling for the mental toughness traits [$F_{(1,350)} = 77.89$; $p < 0.001$]. In the final adjusted model, trait anxiety and Confidence were statistically significant.

For Sample B, in the first step, the model was statistically significant $F_{(4,342)} = 105.41$; $p < 0.001$ and explained 55.2% of variance in state depression. Three of the four mental toughness

TABLE 4 | Hierarchical multiple regression models for Sample A ($n = 372$).

Stress														Depression							State anxiety (STAI-Y1)							Anxiety (DASS21)						
Change														Change							Change							Change						
R	R ²	B	SE	β	t	R	R ²	B	SE	β	t	R	R ²	B	SE	β	t	R	R ²	B	SE	β	t											
Step 1	0.56	0.31***				0.64	0.41***					0.63	0.4***					0.57	0.33***															
Challenge			-0.16	1.09	-0.01	-0.15			0.72	1	0.05	0.72			-1.73	1.33	-0.08	-1.3			-0.76	0.83	-0.06	-0.92										
Commitment			-0.38	1.01	-0.02	-0.37			-2.25	0.92	-0.15*	-2.43			0.97	1.23	0.05	0.79			-0.38	0.77	-0.03	-0.49										
Control			-8.05	1.42	-0.43***	-5.67			-3.69	1.3	-0.2**	-2.85			-10.11	1.73	-0.42***	-5.85			-5.35	1.08	-0.37***	-4.94										
Confidence			-2.04	1.22	-0.13	-1.68			-6.03	1.11	-0.39***	-5.42			-4.36	1.48	-0.22**	-2.94			-2.01	0.93	-0.17*	-2.17										
Step 2	0.66	0.43**	0.12***			0.72	0.52***					0.76	0.57***	0.17***				0.65	0.42***	0.09***														
Challenge			-0.21	1	-0.01	-0.21			0.68	0.9	0.04	0.75			-1.8	1.13	-0.09	-1.6			-0.8	0.78	-0.06	-1.02										
Commitment			0.55	0.93	0.04	0.59			-1.38	0.84	-0.09	-1.63			2.4	1.05	0.12*	2.29			0.25	0.73	0.02	0.34										
Control			-4.4	1.36	-0.23**	-3.23			-0.26	1.24	-0.01	-0.21			-4.45	1.54	-0.18**	-2.89			-2.89	1.06	-0.2**	-2.72										
Confidence			1.92	1.2	0.12	1.6			-2.29	1.09	-0.15*	-2.1			1.79	1.36	0.09	1.32			0.66	0.94	0.06	0.71										
Trait anxiety			0.48	0.06	0.58***	8.5			0.45	0.05	0.55***	8.83			0.74	0.06	0.7***	11.66			0.32	0.04	0.5***	7.33										

Statistical significance: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

TABLE 5 | Hierarchical multiple regression models for Sample B ($n = 347$).

	Stress					Depression					State anxiety (STAI-Y1)					Anxiety (DASS21)								
	R	R ²	B	SE	β	t	R	R ²	B	SE	β	t	R	R ²	B	SE	β	t	R	R ²	B	SE	β	t
Change																								
Step 1	0.690	0.47***					0.740	0.55***					0.68	0.47***					0.650	0.43***				
Challenge			4.45	1.17	0.22***	3.81			5.14	1.11	0.24***	4.64			-1.85	1.16	-0.09	-1.6			4.56	1.29	0.21***	3.53
Commitment			-7.93	1.18	-0.44***	-6.73			-9.05	1.12	-0.49***	-8.1			-1.18	1.17	-0.07	-1.01			-9.71	1.3	-0.51***	-7.44
Control			-9.84	1.61	-0.42***	-6.12			-10.03	1.53	-0.41***	-6.57			-8.48	1.59	-0.36***	-5.32			-10.38	1.78	-0.41***	-5.82
Confidence			-0.1	1.52	-0.004	-0.06			-0.92	1.45	-0.04	-0.63			-4.89	1.51	-0.24**	-3.24			3.15	1.69	0.14	1.87
Step 2	0.790	0.63***	0.16**				0.820	0.68***	0.13***				0.78	0.61***	0.14***				0.720	0.52***	0.09***			
Challenge			4.39	0.98	0.22***	4.46			5.08	0.94	0.24***	5.4			-1.9	1.	-0.1	-1.91			4.51	1.19	0.21***	3.79
Commitment			-5.11	1.02	-0.29***	-5.02			-6.43	0.98	-0.35***	-6.6			1.42	1.04	0.08	1.37			-7.42	1.23	-0.39***	-6.02
Control			-3.84	1.45	-0.16**	-2.65			-4.46	1.38	-0.18**	-3.22			-2.95	1.47	-0.13*	-2.01			-5.51	1.75	-0.22**	-3.15
Confidence			4.09	1.33	0.19**	3.08			2.98	1.27	0.14*	2.34			-1.03	1.35	-0.05	-0.76			6.55	1.61	0.29***	4.07
Trait anxiety			0.68	0.06	0.68***	11.89			0.64	0.06	0.61***	11.56			0.63	0.06	0.64***	10.78			0.56	0.07	0.52***	7.99

Statistical significance: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

traits made a significant unique contribution to the model (see Table 5). After entry of trait anxiety at Step 2 the total variance explained by the model as a whole was 67.8% [$F_{(5,341)} = 143.71$; $p < 0.001$]. The introduction of trait anxiety explained an additional 12.6% of variance in state depression, after controlling for the mental toughness traits [$F_{(1,341)} = 133.52$; $p < 0.001$]. In the final adjusted model, all five predictor variables were statistically significant.

State Anxiety (STAI-Y1)

A HMR was next used to predict state anxiety (STAI-Y1) within Sample A. In the first step, the model was statistically significant [$F_{(4,339)} = 56.06$; $p < 0.001$] and explained 40% of variance in state anxiety. Two of the four mental toughness traits made a significant unique contribution to the model (see Table 4). After entry of trait anxiety at Step 2 the total variance explained by the model as a whole was 57% [$F_{(5,338)} = 89.89$; $p < 0.001$]. The introduction of trait anxiety explained an additional 17.3% of variance in state anxiety, after controlling for the mental toughness traits [$F_{(1,338)} = 135.96$; $p < 0.001$]. In the final adjusted model, trait anxiety, Control and Commitment were statistically significant.

For Sample B, in the first step, the model was statistically significant [$F_{(4,342)} = 75.12$; $p < 0.001$] and explained 46.8% of variance in state anxiety. Two of the four mental toughness traits made a significant unique contribution to the model (see Table 5). After entry of trait anxiety at Step 2 the total variance explained by the model as a whole was 60.3% [$F_{(5,341)} = 103.58$; $p < 0.001$]. The introduction of trait anxiety explained an additional 13.5% of variance in state anxiety, after controlling for the mental toughness traits [$F_{(1,341)} = 116.21$; $p < 0.001$]. In the final adjusted model, trait anxiety and Control were statistically significant.

Anxiety (DASS21)

A HMR was next used to predict anxiety (DASS21) within Sample A. In the first step, the model was statistically significant [$F_{(4,351)} = 43.04$; $p < 0.001$] and explained 33% of variance in anxiety (DASS21). Two of the four mental toughness traits made a significant unique contribution to the model (see Table 4). After entry of trait anxiety at Step 2 the total variance explained by the model as a whole was 42% [$F_{(5,338)} = 89.89$; $p < 0.001$]. The introduction of trait anxiety explained an additional 8.9% of variance in anxiety (DASS21), after controlling for the mental toughness traits [$F_{(1,350)} = 53.78$; $p < 0.001$]. In the final adjusted model, trait anxiety and Control were statistically significant.

For Sample B, in the first step, the model was statistically significant [$F_{(4,342)} = 63.76$; $p < 0.001$] and explained 42.7% of variance in anxiety (DASS21). Three of the four mental toughness traits made a significant unique contribution to the model (see Table 5). After entry of trait anxiety at Step 2 the total variance explained by the model as a whole was 51.7% [$F_{(5,341)} = 73.14$; $p < 0.001$]. The introduction of trait anxiety explained an additional 9% of variance in anxiety (DASS21), after controlling for the mental toughness traits [$F_{(1,341)} = 63.82$; $p < 0.001$]. In the final adjusted model, all five predictor variables were statistically significant.

TABLE 6 | MT scores for job outcome group.

	Job outcome					Statistics
	Job loss	Furloughed	Previously unemployed	Working (traveling)	Working (home)	
<i>N</i>	64	106	109	146	279	
	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	
Challenge	3.3 (0.55)	3.31 (0.54)	3.51 (0.66)	3.42 (0.59)	3.49 (0.55)	$F_{(4,698)} = 0.334, p = 0.01$
Commitment	3.14 (0.5)	3.31 (0.62)	3.44 (0.74)	3.35 (0.62)	3.48 (0.61)	$F_{(4,698)} = 4.66, p = 0.001$
Control	2.89 (0.42)	3 (0.5)	3.22 (0.58)	3.08 (0.47)	3.2 (0.46)	$F_{(4,698)} = 8.56, p < 0.001$
Confidence	3.08 (0.52)	3.15 (0.6)	3.31 (0.73)	3.24 (0.56)	3.35 (0.53)	$F_{(4,698)} = 4.54, p = 0.001$

Employment Status as a Predictor of Mental Toughness and Affective State

As illustrated in the **Table 1**, there were some proportional differences in employment status between the samples. Most notably, very few participants from Sample A had lost their job/business during the pandemic, in comparison to Sample B. To ensure that all employment status groups had a sufficient number of cases for reliable comparisons to be made, data from the two samples were combined for the subsequent analyses.

Employment Status and Mental Toughness

A between-groups multivariate analysis of variance was conducted to explore the impact of employment status on MT traits (Challenge, Commitment, Control, & Confidence). Descriptive and inferential statistics for MT differences between employment status groups are presented in **Table 6**. There was a statistically significant main effect for employment, [$F_{(16,2123.9)} = 2.56, p = 0.001$; Wilks' $\Lambda = 0.94$]. Univariate comparisons found a significant main effect for job outcome on all MT traits, inferential statistics are presented in **Table 6**. Further *post-hoc* Tukey comparisons are presented in **Table 7** and discussed below.

Post-hoc comparisons for Challenge scores indicated that the mean score for furloughed participants was significantly lower than WFH participants; the difference between the groups was small. For Commitment scores, *post-hoc* tests indicated that the mean score for Commitment in job/business loss participants was significantly lower than WFH participants and previously unemployed participants; these differences were moderate and small, respectively. In relation to Control scores, *post-hoc* tests indicated that the mean score for job/business loss participants was significantly lower than WFH participants and previously unemployed participants. Both differences were moderate. Additionally, the mean score for Control in furloughed participants was significantly lower than WFH participants and previously unemployed participants. The differences here were small. Finally, for Confidence, *post-hoc* comparisons indicated that the mean score for WFH participants was significantly higher than furloughed participants and job/business loss participants. The differences were small and moderate, respectively.

TABLE 7 | Significant *post-hoc* comparisons for job outcome and MT.

	Statistics		
	<i>p</i>	95% CI	<i>d</i>
Challenge			
Furloughed < WFH	0.05	−0.36 to −0.001	0.33
Commitment			
Job loss < WFH	0.001	−0.57 to −0.1	0.57
Job loss < previously unemployed	0.02	−0.57 to −0.03	0.44
Control			
Job loss < WFH	<0.001	−0.5 to −0.13	0.69
Job loss < previously unemployed	<0.001	−0.54 to −0.13	0.63
Furloughed < WFH	0.004	−35 to −0.04	0.42
Furloughed < previously unemployed	0.01	−0.4 to −0.04	0.41
Confidence			
Job loss < WFH	0.01	0.05 to 0.5	0.51
Furloughed < WFH	0.02	0.02 to 0.39	0.36

Employment Status and Negative Affective State

Lastly, four moderation analyses were carried out using hierarchical regressions to determine whether MT traits moderated the effects of different job outcomes on negative affective states (state anxiety, DASS21 anxiety, depression and stress). A dummy coding procedure was used to test the predictive abilities of each individual job outcome, with WFH as the reference category. The moderator variables (Challenge, Commitment, Control, & Confidence) were centered to allow the effect of the predictor to be distinguishable from the interaction. For each regression, the first step included the predictor (job outcome) and centered moderator variables (Challenge, Commitment, Control, & Confidence) and the second step introduced the interactions between these variables. The inferential properties for all four models are parented in **Table 8**.

The final model for state anxiety (STAI-Y1) was statistically significant [$F_{(24,676)} = 22.99; p < 0.001$] and explained 44.9% of variance. Job loss, Challenge, Control and Confidence made

TABLE 8 | Hierarchical multiple regressions for emotional states.

	SA						Depression						Anxiety						Stress					
	<i>R</i>	<i>R</i> ²	<i>B</i>	<i>SE</i>	β	<i>t</i>	<i>R</i>	<i>R</i> ²	<i>B</i>	<i>SE</i>	β	<i>t</i>	<i>R</i>	<i>R</i> ²	<i>B</i>	<i>SE</i>	β	<i>t</i>	<i>R</i>	<i>R</i> ²	<i>B</i>	<i>SE</i>	β	<i>t</i>
Step 1	0.66	0.43					0.68	0.46					0.69	0.34					0.62	0.38				
Job loss			3.6	1.29	0.09**	2.79			4.49	1.14	0.12***	3.92			4.68	1.23	0.13***	3.81			3.59	1.2	0.1**	3.01
Furloughed			−0.02	1.05	−0.001	−0.02			−0.31	0.93	−0.01	−0.34			−0.88	1.	−0.03	−0.87			−1.33	0.97	−0.04	−1.36
Working (t)			0.6	0.94	0.02	0.64			0.1	0.83	0.004	0.12			1.81	0.89	0.07*	2.03			1.59	0.87	0.06	1.84
P.Unemployed			−0.65	1.03	−0.02	−0.63			−1.52	0.92	−0.05	−1.66			−1.63	0.99	−0.05	−1.65			−1.56	0.96	−0.05	−1.63
Challenge			−1.93	0.88	−0.09*	−2.2			2.75	0.78	0.15***	3.54			1.45	0.83	0.08	1.74			1.85	0.81	0.1*	2.28
Commitment			−0.22	0.82	−0.01	−0.27			−6.27	0.73	−0.36***	−8.59			−5.9	0.78	−0.35***	−7.52			−4.34	0.76	−0.26***	−5.7
Control			−9.15	1.17	−0.38***	−7.8			−6.58	1.04	−0.3***	−6.34			−7.83	1.12	−0.37***	−7.01			−9.12	1.09	−0.43***	−8.4
Confidence			−4.23	1.03	−0.21***	−4.12			−2.87	0.91	−0.15**	−3.15			1.75	0.98	0.1	1.79			−0.42	0.95	−0.02	−0.44
Step 2	0.67	0.45					0.69	0.47					0.61	0.37					0.64	0.41				
Job loss			4.23	1.49	0.1**	2.85			4.22	1.32	0.11**	3.2			4.89	1.4	0.13**	3.48			4.89	1.37	0.13***	3.57
Furloughed			−0.19	1.07	−0.01	−0.17			−0.02	0.95	−0.001	−0.03			−0.77	1.01	−0.03	−0.76			−1.21	0.99	−0.04	−1.23
Working (t)			0.71	0.94	0.02	0.75			0.012	0.83	0.0004	0.02			1.64	0.88	0.06	1.86			1.48	0.86	0.06	1.72
P.Unemployed			−0.29	1.05	−0.01	−0.27			−1.51	0.93	−0.05	−1.62			−1.7	0.99	−0.06	−1.71			−1.49	0.97	−0.05	−1.54
Challenge			−4.88	1.46	−0.24**	−3.36			1.82	1.29	0.1	1.41			2.15	1.38	0.12	1.57			2.74	1.34	0.15*	2.04
Commitment			−0.02	1.44	−0.001	−0.02			−5.36	1.28	−0.31***	−4.18			−5.74	1.36	−0.34***	−4.21			−4.63	1.33	−0.27**	−3.48
Control			−5.93	1.98	−0.25**	−3.			−7.4	1.75	−0.34***	−4.22			−9.29	1.87	−0.44***	−4.97			−10.32	1.82	−0.48***	−5.67
Confidence			−3.57	1.73	−0.18*	−2.07			−1.42	1.53	−0.08	−0.93			2.38	1.63	0.13	1.46			0.7	1.59	0.04	0.44
JLxChal			2.41	3.44	0.03	0.7			−1.18	3.05	−0.02	−0.39			−4.74	3.25	−0.07	−1.46			−6.42	3.17	−0.1*	−2.03
FxChal			3.19	2.77	0.06	1.15			3.2	2.46	0.06	1.3			−0.07	2.62	−0.001	−0.03			−0.16	2.55	−0.003	−0.06
WxChal			5.5	2.46	0.12*	2.24			1.72	2.19	0.04	0.78			−2.42	2.33	−0.06	−1.04			−0.65	2.27	−0.02	−0.29
PUxChal			4.6	2.47	0.1	1.84			−0.06	2.19	−0.001	−0.03			−1.02	2.34	−0.03	−0.44			−2.53	2.28	−0.06	−1.11
JLxComm			−1.7	3.03	−0.02	−0.55			−3.59	2.69	−0.05	−1.34			−5.36	2.87	−0.08	−1.87			−2.31	2.79	−0.04	−0.83
FxComm			4.12	2.55	0.08	1.62			1.11	2.26	0.02	0.49			3.57	2.41	0.08	1.48			1.37	2.34	0.03	0.59
WxComm			−3.23	2.34	−0.08	−1.38			−3.73	2.07	−0.1	−1.8			−3.88	2.21	−0.1	−1.76			−0.99	2.15	−0.03	−0.46
PUxComm			−0.01	2.37	0.0003	−0.01			0.39	2.11	0.01	0.18			3.31	2.24	0.09	1.48			3.6	2.19	0.1	1.65
JLxCont			−0.37	4.11	−0.004	−0.09			0.76	3.64	0.01	0.21			5.18	3.88	0.07	1.33			9.96	3.78	0.13**	2.63
FxCont			−8.9	3.62	−0.15*	−2.45			4.13	3.21	0.07	1.29			4.19	3.42	0.08	1.22			3.36	3.33	0.06	1.01
WxCont			−3.23	3.28	−0.06	−0.98			−2.33	2.91	−0.05	−0.8			−0.87	3.1	−0.02	−0.28			−3.64	3.02	−0.07	−1.21
PUxCont			−6.31	3.42	−0.12	−1.85			2.38	3.03	0.05	0.79			1.74	3.23	0.04	0.54			1.78	3.14	0.04	0.57
JLxConf			0.57	4.18	0.01	0.14			1.71	3.71	0.03	0.46			5.52	3.95	0.08	1.4			1.98	3.85	0.03	0.51
FxConf			−0.97	3.1	−0.02	−0.31			−6.91	2.75	−0.15*	−2.51			−5.6	2.93	−0.12	−1.91			−4.06	2.85	−0.09	−1.42
WxConf			0.37	3.1	0.01	0.12			0.93	2.75	0.02	0.34			4.1	2.93	0.1	1.4			2.79	2.86	0.07	0.98
PUxConf			−1.48	2.76	−0.04	−0.54			−2.98	2.45	−0.08	−1.21			−3.26	2.61	−0.09	−1.25			−4.31	2.55	−0.11	−1.69

P* < 0.05, *P* < 0.01, ****P* < 0.005.

a significant contribution to the model. The interaction terms *working (traveling) x Challenge* and *furloughed x Control* were also significantly associated with state anxiety (see **Figures 1, 2**, respectively).

The final model for depression was statistically significant [$F_{(24,690)} = 25.76; p < 0.001$] and explained 47.3% of variance. Job loss, Commitment and Control made a significant contribution to the model. The interaction term *furloughed x Confidence* was also significantly associated with depression (see **Figure 3**).

The final model for anxiety (DASS21) was statistically significant [$F_{(24,689)} = 16.98; p < 0.001$] and explained 37.2% of variance. Job loss, Commitment and Control made a significant contribution to the model. There were no significant associations between the outcome and the interaction terms.

The final model for stress was statistically significant [$F_{(24,689)} = 19.8; p < 0.001$] and explained 40.8% of variance. Job loss, Challenge, Commitment and Control made a significant contribution to the model. The interaction terms *job loss x Challenge* and *Job loss x Control* were also significantly associated with stress (see **Figures 4, 5**).

DISCUSSION

Individuals who had lost their jobs during the pandemic reported higher levels of depression, anxiety and stress; and lower levels of MT, compared to those who had remained employed. However, across the samples, self-reported symptoms of depression, anxiety and stress were less severe among mentally tough individuals, with MT having a moderating effect on the impact of employment status on mental health. The present study's findings, and their practical implications, are discussed further below.

Participants from Sample B reported higher scores on the DASS21 subscales in comparison to Sample A. One possible explanation for the differences in scores could be the timing of data collection periods, with the majority of participants from Sample B completing the survey at a later period during the pandemic (on May 25th, 2020). Higher death rates, stricter lockdown regulation and greater financial impact on the economy may have led to higher reports of stress, anxiety and depression. However, findings from other COVID-19 studies found that DASS21 scores remained stable throughout the initial lockdown period [see (15)]. The demographic differences between the samples could also explain the differences in scores. Sample A was an exclusively UK cohort whereas Sample B was comprised of participants from a diverse range of countries. Although DASS21 scores appear to be consistent cross-culturally (62), differences in each country's response to controlling the virus may have resulted in changes to the negative affective states of the participants – further evidence on individuals' attitudes to the pandemic would be needed to support this assertion. Other demographic factors that could explain the higher DASS21 scores within Sample B include a greater proportion of men and individuals who had lost their jobs during the pandemic. However, due to the demographic and methodological (data collection platform and time) differences

between the two datasets, it is not possible to confidently identify the lead contributor for the disparity in DASS21 scores. More importantly, our discussion of the results focusses on the disparities in negative affective states between the current samples and pre-COVID-19 samples from previous research.

Participants from both samples reported noticeably higher levels of depression, anxiety and stress than participants from previous pre-COVID-19 research. Crawford et al. (63) reported mean scores of 5.14, 3.48, 7.98, and 36.35 for depression, anxiety (DASS21), stress and STAI-Y1, respectively, for Australian adults during 1995–2000¹. This was proportionately lower than the mean scores of participants from Samples A (10.99, 7.01, 13.32, and 42.7) and B (16.32, 15.2, 17.48, and 44.36). Whilst we cannot definitively confirm the cause for the disparity in scores, it is possible that the distinct differences in affective states could be a result of situational factors brought on by the recent pandemic – however, this ascription should only be taken as speculation due to Crawford's sample not being studied by the present researchers.

Association Between MT and Negative Affective States

We hypothesized that MT traits would be negatively associated with depression (*H1*), anxiety (*H2*), and stress (*H3*). Partial correlations identified significant negative associations between all MT traits and the depression, anxiety and stress measures, supporting the first three hypotheses. However, after entering the predictors into hierarchical regression models and controlling for trait anxiety, the association between some of the MT traits and the negative affective states were not significant. The reduction in significant associations could be attributed to the high levels of inter-correlation between the MT traits and trait anxiety reducing the additional contribution each predictor made to the model. There were more significant associations between the MT predictors and negative affective states within Sample B, with all four forms of MT being associated with depression, anxiety (DASS21) and stress; and the Control variable being associated with STAI-Y1 as well. The increased level of associations within Sample B could be due to the participants' higher levels of anxiety, stress and depression accentuating the observed relationships between MT and the aforementioned states. Additionally, and unexpectedly, some of the associations between MT and negative affective states appeared to show a positive relationship in the final regression models. This was most notable within Sample B, where the Challenge and Confidence traits had positive standardized coefficients when predicting stress, depression and anxiety (DASS21); and within Sample A, where Commitment had a positive coefficient when predicting STAI-Y1. However, the directions of these associations were not reflected in the initial partial correlations, nor were they present within the moderation analysis of the combined sample, leading the authors to speculate that they may have been the result of a *suppressor effect* from other MT traits.

¹The raw DASS21 scores were multiplied by 2, as instructed by the DASS21 manual [see (49)] to make the scores comparable to the present samples'.

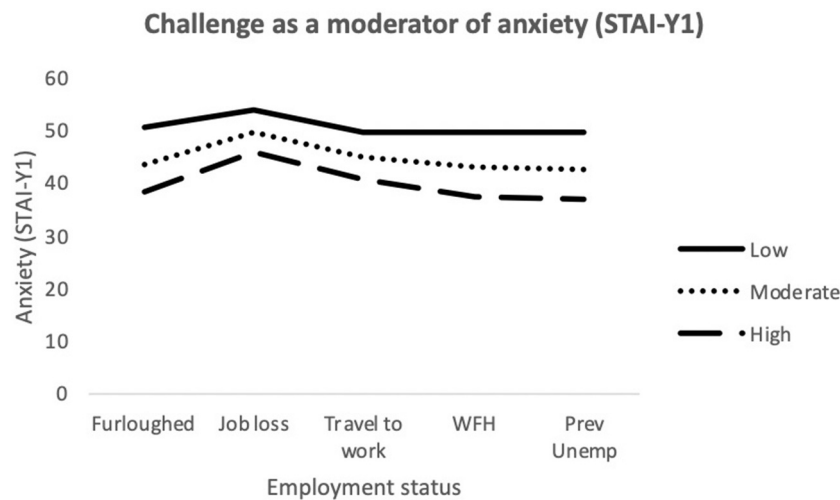


FIGURE 1 | Interaction between job outcome and Challenge for State Anxiety. *WFH*, Employed (working from home); *Prev Unemp*, previously unemployed.

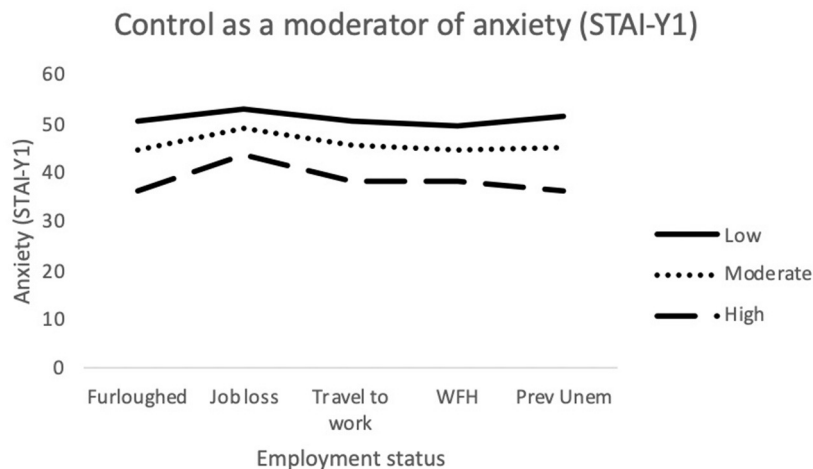


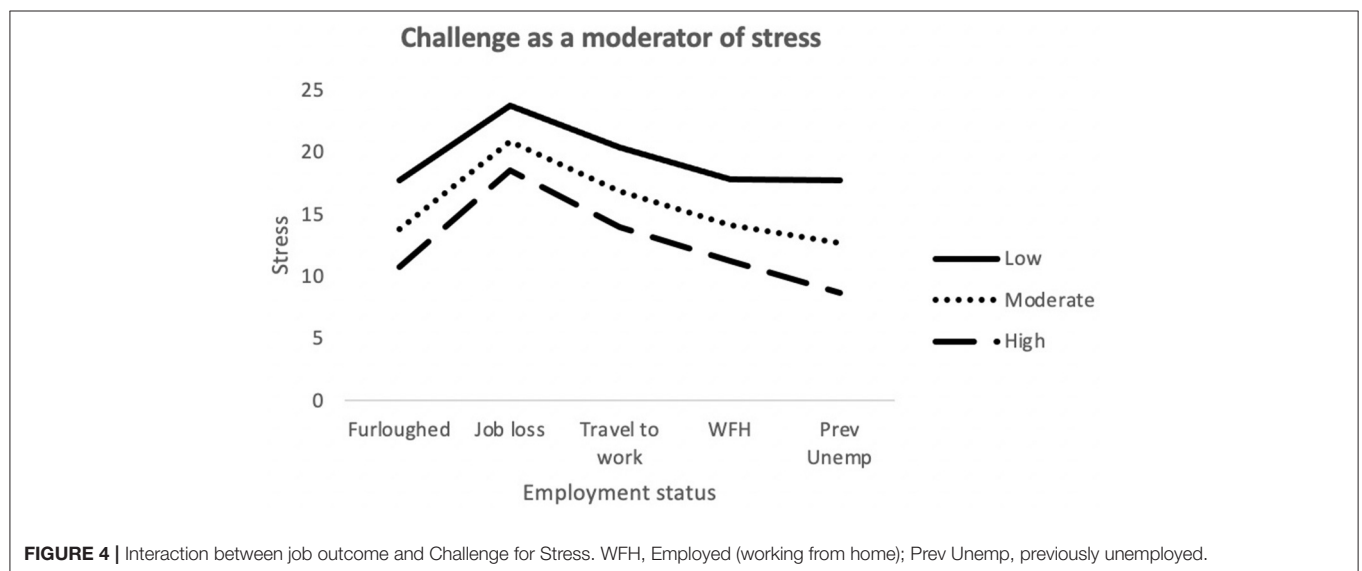
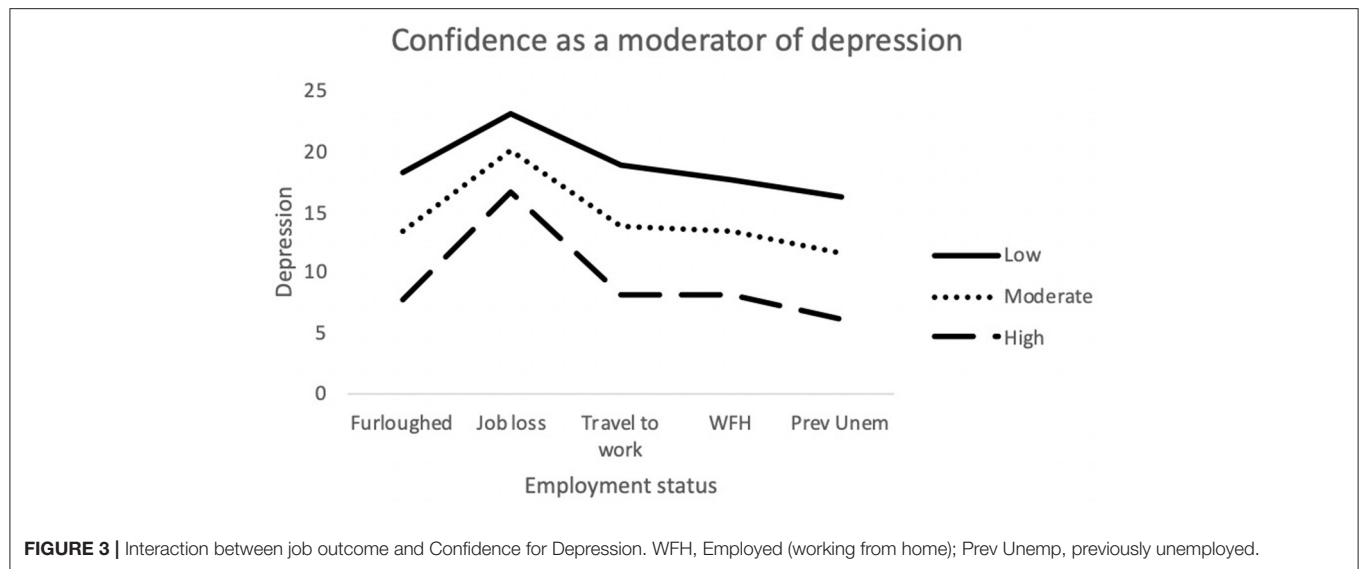
FIGURE 2 | Interaction between job outcome and Control for State Anxiety. *WFH*, Employed (working from home); *Prev Unemp*, previously unemployed.

The relationship between MT and stress can be explained using the *cognitive-transactional stress* theory. According to the model, stress is provoked when the perceived demands of a situation outweigh an individual's ability to cope with the stressor (64). Haghighi and Gerber (38) explained that mentally tough individuals may perceive events as being less stressful due to perceiving their selves as having greater control over the situation, being more capable of staying committed under stress and being better equipped to overcome the issue. Furthermore, Clough et al. (35) defined the Challenge element of MT as the ability to regard problematic events as challenges rather than threats. The same characteristics that allow mentally tough individuals to perceive threatening situations as being less stressful can also reduce the level of anxiety they exhibit. That is, mentally tough individuals with greater confidence in their abilities and perceived control over stressful events are less likely

to worry or exhibit fear over them. The relationship between depression and MT was also to be expected, given the clear incompatibility between MT traits and depressive symptoms (i.e., hopelessness, withdrawal and avoidance) (38).

Changes in Employment Status During the Pandemic

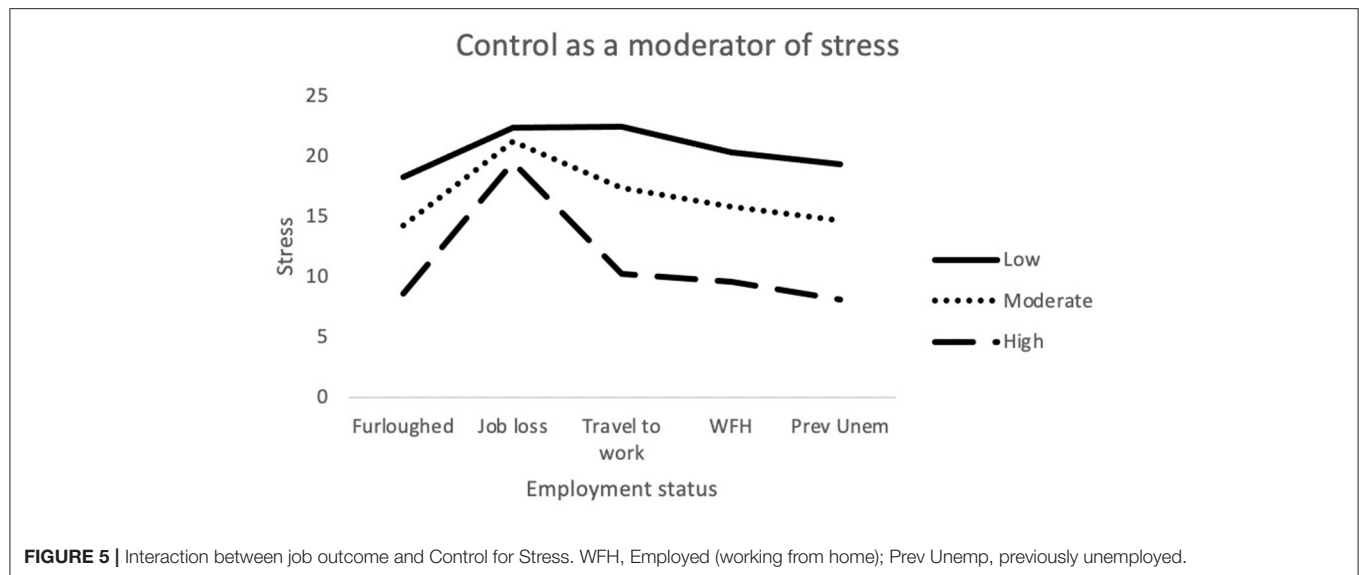
Results indicated that job/business loss was a significant predictor of anxiety, depression and stress, supporting hypotheses 4, 5, and 6. Our findings align with previous research that had identified a link between job loss and depressive symptoms (65, 66), and also with more recent research showing a relationship between temporary job loss and stress during the COVID-19 pandemic (2). Mimoun and colleagues explained that jobs “provide individuals a sense of confidence, self-esteem, and control” (2, p. 184). Thus, the removal of one's employment is likely to reduce their sense of value and purpose, consequently



leading to an increase in depressive symptoms. The effects of recent unemployment with stress and anxiety were also to be expected as the economic hardship brought on by unemployment can often provoke heightened levels of stress and anxiety amongst individuals lacking financial stability (67).

Moderation analyses were used to assess the utility of MT as a protective factor against the adverse effects brought on by recent changes in employment. Multiple significant interactions between MT and employment status were identified when attempting to predict depression, anxiety and stress. For anxiety (STAI-Y1), there were significant interactions between traveling to work and Challenge scores. As illustrated in **Figure 1**, among participants who were traveling to work during the pandemic, those who possessed low levels of the Challenge trait still exhibited greater levels of anxiety, despite still being in employment. The Challenge characteristic is defined as an individual's tendency to adapt to changing environments and

perceive potential threats as opportunities for growth (35). As such, individuals scoring low on this trait may have been less able to overcome the changes in their work environments and more likely to worry about the increased risk of viral contamination. There was also an interaction effect between getting furloughed and Control scores. Furloughed individuals with high Control scores reported less anxiety than those with moderate and low scores. Furloughed individuals with high levels of perceived Control may see temporary unemployment as a more manageable and solvable issue and would be better equipped to manage their emotions whilst awaiting their return to work. For depression, there was a significant interaction between getting furloughed and Confidence. It is possible that individuals with higher levels of confidence would be less likely to interpret temporary unemployment as a reflection of their professional worth and thus, would be less likely to experience depressive symptoms as a result. Finally, for stress,



job loss significantly interacted with both Challenge and Control. The perceived stressfulness of an event is influenced by the individual's perceived ability to cope with the new threat (68). Research has shown that high MT is associated with both coping self-efficacy and coping effectiveness (69, 70). Furthermore, individuals who score low on the Challenge scale are less able to adapt to changing environments than individuals with higher scores. As a result, the loss of employment is likely to be handled less effectively by people who are not mentally tough. Individuals with high levels of Control generally reported lower levels of stress in comparison to participants with low or moderate levels. However, Control did not appear to provide much protection against stress for those who had lost their job/business during the pandemic. As **Figure 5** illustrates, participants with high levels of Control still reported high levels of stress, similar to the levels reported by participants with lower levels of Control. The findings suggest that whilst the Control element of MT can allow individuals to cope with stress better during the pandemic, the perceived stressfulness of unemployment during the pandemic may outweigh their perceived abilities to deal with situation.

Stability of Mental Toughness During the Pandemic

The present findings suggest that MT could be susceptible to environmental influence. Whilst the present study's cross-sectional design cannot prove that changes in employment status will have had a direct impact on MT, comparisons between the employment status groups indicated that those who had lost their jobs/business or become furloughed reported lower levels of MT than those who were working from home. Sudden loss of employment can have a negative impact on an individual's perceived level of control over their life and confidence in their own abilities. Previous research supports the notion of MT being a dynamic trait, however changes in MT have typically been measured in relation to growth over time (59, 71); our findings suggest that MT may also be susceptible to regressing.

Our observations suggest that despite the protective utility for mental health, MT is susceptible to environmental influence.

Based on these observations, we argue that attempts to preserve and strengthen public MT should and could be attempted by health organizations. The notion of using MT building strategies to improve the well-being of individuals has been proposed in the past. Gucciardi and Jones (44) proposed using interventions that targeted MT as a way of improving the well-being of vulnerable individuals and Gerber et al. (37) argued that training MT would be particularly useful for supporting the mental health of individuals who may be difficult to reach with more typical health interventions. The potential for improving MT through clinical practice has been evidenced within sport-related contexts. Psychological skills training (PST) interventions [e.g., (72)] have been successful in using routine coaching activities (including goal setting, visualization, relaxation and thought stoppage) to enhance psychological qualities that underpin MT (i.e., hardiness, self-esteem, self-efficacy, dispositional optimism, positive affectivity) (73, 74). PST interventions could therefore provide individuals vulnerable to stress, depression and anxiety during a pandemic—such as recently unemployed individuals—with the necessary psychological prerequisites to maintain emotional resilience. This is because the aforementioned qualities of MT are incompatible with symptoms of stress and depression (e.g., irritability and hopelessness) and as such could mitigate the adverse effects of a pandemic.

LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

The present study is the first to examine the role of MT as a protective factor for mental health during the Covid-19 pandemic. Undoubtedly, some limitations exist that require acknowledgment. Firstly, the cross-sectional design of the study meant that we were unable to measure the respondents' MT and state of mental health before or at the early stages of the pandemic. As a result, we cannot reliably determine how much of an impact the pandemic had on MT and mental

health. A longitudinal design would have enabled us to assess the utility of MT as a protective factor against the pandemic's adverse effects on mental health more accurately by observing the interactions between MT and time on self-reported stress, anxiety and depression. Similarly, without a longitudinal design, it is difficult to confidently determine the extent to which MT can be influenced by environmental factors such as job loss. Whilst it is impossible to retrospectively assess MT and mental health scores of individuals at the start of the pandemic, new longitudinal research monitoring individuals' MT scores as society continues to adapt to the effects of COVID-19 could provide further insight into the stability of MT during a pandemic. Building on this, future research should examine whether interventions aimed at improving MT could succeed and whether the interventions can lead to reductions in stress, anxiety and depression.

A second data collection (Sample B) was conducted to gather a larger sample for inferential testing and to determine whether the associations between MT and negative affective states could be replicated within a sample that differed geographically. Unfortunately, we were unable to control or match the sample for other potential extraneous variables (i.e., time of data collection, gender and employment distribution). Due to multiple salient differences between the samples, it is not possible to reliably ascribe an explanation for the differences in negative affective state.

Finally, our study measured employment status through five nominal categories (job/business loss during the pandemic, furloughed, traveling to work, working from home and previously unemployed) but failed to distinguish those who were retired or students. It is possible that these individuals may have had a confounding effect on the observed relationship between employment status and mental health. This is possible given that many students have reported experiencing greater psychological impact due to disruption to their educational environments (75). In addition to this, the conditions of temporary unemployment (furloughed) will have differed for each participant. Whilst many furloughed individuals within the UK still received some financial support during the period, this was not the case for many others (2). Thus, we acknowledge that a more precise measure of employment could have provided us with a more complete understanding of the effects of the pandemic on different groups.

CONCLUSION

The observed severity of depression, anxiety and stress within our samples highlight the psychological impact of the current climate, however the results also suggest that MT could suppress some of these effects. Thus, the practical implications of the present findings highlight the potential for MT-based interventions to

be used as a means for boosting individuals' resilience to the adverse mental health effects of the pandemic. Past research has demonstrated that not only can MT-related traits (such as hardiness and positive affectivity) be enhanced through PST, but that such enhancements could help build up resilience to negative emotions within stressful situations. Despite this, our understanding of the mental impact of the pandemic is still at a relatively early stage and further longitudinal research is required to better understand the psychological consequences of COVID-19. A practical step forward from the current research would be to determine whether MT can be improved through short-term interventions and whether such an approach could help improve the emotional resilience of individuals during a pandemic.

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found at: <https://osf.io/zebhj>.

ETHICS STATEMENT

This study involving human participants was reviewed and approved by the ethics review panel from the University of Huddersfield. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

The project was created by DM and PC. DM conducted the data analysis, data collection, and manuscript writeup. ND contributed to the writeup of the introduction and methodology and provided guidance on the research design. AD contributed to the writeup of the results. PC contributed to the writeup of the introduction and design of the study. KP provided guidance on the analytical protocol, study design, and contributed to the writeup of the results. SH contributed to the design of the study and to data collection. DC and CL contributed to data collection and the editing of the manuscript. All authors contributed to the article and approved the submitted version.

FUNDING

The project received internal funding from the Center for Cognition and Neuroscience, University of Huddersfield to assist with data collection of Sample B.

ACKNOWLEDGMENTS

The authors would like to thank Miss Mollie Hood for her assistance with the sampling procedure.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Impact of SARS-CoV-2 Infection on Cognitive Function: A Systematic Review

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OPEN ACCESS

Edited by:

Alessandro Colasanti,
Brighton and Sussex Medical School,
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University of Copenhagen, Denmark
Maurice Preter,
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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 27 October 2020

Accepted: 22 December 2020

Published: 10 February 2021

Citation:

Alnefeesi Y, Siegel A, Lui LMW, Teopiz KM, Ho RCM, Lee Y, Nasri F, Gill H, Lin K, Cao B, Rosenblat JD and McIntyre RS (2021) Impact of SARS-CoV-2 Infection on Cognitive Function: A Systematic Review. *Front. Psychiatry* 11:621773. doi: 10.3389/fpsy.2020.621773

The prevalence and etiology of COVID-19's impact on brain health and cognitive function is poorly characterized. With mounting reports of delirium, systemic inflammation, and evidence of neurotropism, a statement on cognitive impairment among COVID-19 cases is needed. A substantial literature has demonstrated that inflammation can severely disrupt brain function, suggesting an immune response, a cytokine storm, as a possible cause of neurocognitive impairments. In this light, the aim of the present study was to summarize the available knowledge of the impact of COVID-19 on cognition (i.e., herein, we broadly define cognition reflecting the reporting on this topic in the literature) during the acute and recovery phases of the disease, in hospitalized patients and outpatients with confirmed COVID-19 status. A systematic review of the literature identified six studies which document the prevalence of cognitive impairment, and one which quantifies deficits after recovery. Pooling the samples of the included studies (total sample $n = 644$) at three standards of quality produced conservative estimates of cognitive impairment ranging from 43.0 to 66.8% prevalence in hospitalized COVID-19 patients only, as no studies which report on outpatients met criteria for inclusion in the main synthesis. The most common impairment reported was delirium and frequent reports of elevated inflammatory markers suggest etiology. Other studies have demonstrated that the disease involves marked increases in IL-6, TNF α , and IL-1 β ; cytokines known to have a profound impact on working memory and attention. Impairment of these cognitive functions is a characteristic aspect of delirium, which suggests these cytokines as key mediators in the etiology of COVID-19 induced cognitive impairments. Researchers are encouraged to assay inflammatory markers to determine the potential role of inflammation in mediating the disturbance of cognitive function in individuals affected by COVID-19.

Keywords: neurotropism, cognitive function, delirium, depression, neuroinflammation, cytokines, COVID-19, brain health

INTRODUCTION

The coronavirus disease 2019 (COVID-19) is a respiratory condition caused by the RNA virus known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The disease can result in several complex syndromes due to far reaching and variable effects on the human body. The virus binds the angiotensin-converting enzyme 2 (ACE2) receptor (1) which induces its internalization (2) and begins its replication cycle (3). In many viral infections, immune cells detect pathogenic RNAs and activate the inflammatory response, which triggers wide-ranging effects that contain the spread of the pathogen (4). However, SARS-CoV-2 can overcome this containment, which results in a positive feedback loop between viral propagation and the release of cytokines/chemokines (5); the molecular signals that regulate inflammation. This mutual amplification causes the disease's characteristic cytokine storm; a destabilizing increase in circulating inflammatory cytokines. The inflammation storm caused by SARS-CoV-2 is the main reason the disease has far reaching physiological effects.

The disease course of COVID-19 involves the elevation of key cytokines such as interleukin-6 (IL-6), tumor necrosis factor- α (TNF α) (3), and interleukin-1 β (IL-1 β), among others (5). Convergent evidence from laboratory, clinical, and epidemiological studies suggest that the foregoing key cytokines, among several others, are produced in greater quantities when the active hormonal form of Vitamin D3 is low (6). Indeed, these findings have shown that Vitamin D3 deficiency is common among COVID-19 patients, and it has been known for decades that the biosynthesis of TNF α and IL-1 β are reduced by calcitriol in a dose dependent manner (7). Furthermore, some of these cytokines can cross the blood brain barrier and prompt their own release from microglia (8). This amplification of the inflammatory signal in the CNS can bias the excitation-inhibition ratio toward excitation (9). The foregoing excitation may explain the disproportionate number of seizures in COVID-19 cases as compared to the typical incidence of seizures observed in intensive care units (ICUs) (10). Due to substantial sequence homology with better characterized coronaviruses, some have speculated that the virus might be neurotropic like many of its predecessors (11). Angiotensin-converting enzyme 2 (ACE2) receptors are expressed in both the nasal cavity and the CNS. Consequently, researchers have proposed that the virus traverses the cribriform plate and infects the brain (10).

The foregoing observations have prompted a recent wave of publications characterizing the neurological and mental health ramifications of SARS-CoV-2 infection (10–15). Although this literature adequately characterized the variety of COVID-19 related neuropsychological conditions, the data on the cognitive effects of the disease are insufficient, and these data are often reported ambiguously. For instance, one of the most widely cited studies on the neurological manifestations of COVID-19, Mao et al. (12), conflated the prevalence of somnolence with that of delirium, by reporting them jointly as “impaired consciousness.” This kind of nebulousity regarding cognitive outcomes is evident throughout the current COVID-19 literature and results are often confounded by pre-existing cognitive

impairment. Nevertheless, several lines of research indicate that even peripheral viral infections or inflammatory signaling may affect cognitive function (16–19). Accordingly, the recognition of SARS-CoV-2 neurotropism (1, 10, 11, 20) as well as significant immune system activation (3, 5, 8) provides the basis for hypothesizing that COVID-19 patients may be susceptible to multi-dimensional cognitive impairments across the domains of the Research Domain Criteria (RDoC) framework (18).

In light of the aforementioned shortcomings of the extant literature, this review aimed to summarize the available knowledge of the impact of COVID-19 on cognition (i.e., herein, we broadly define cognition reflecting the reporting on this topic in the literature) during the acute and recovery phases of the disease, in hospitalized patients and outpatients with confirmed COVID-19 status. The prevalence of cognitive impairments among hospitalized COVID-19 adult cases has been quantified, and the most prevalent types of cognitive conditions have been reported. No studies which report on outpatients met criteria for inclusion in the main synthesis of the present study. Non-primary sources and publications with conspicuous signs of selective reporting (e.g., selected cases of cognitive impairment) have been excluded from the main synthesis and are referenced, either directly or indirectly, only as sources of etiological insight.

MATERIALS AND METHODS

This review has been registered on PROSPERO (ID: CRD42020201232) prior to its commencement and was conducted in accordance with the recommendations of the PRISMA statement (21). Much of the relevant methodological details were described and updated on PROSPERO throughout the review process.

Search Strategy

A systematic search of the literature was conducted on CINAHL Plus, MEDLINE, EMBASE, and APA PsycINFO. A manual citation search was conducted in the reference lists of articles included in full-text screening. As shown in **Table 1**, the searches involved both the “cognition” and the “COVID-19” concepts on all databases. Functional synonyms were used for COVID-19, and the word “cognition” was truncated to include all variations of the term. Time of publication was restricted to the interval between 2019 and 26/08/2020. EMBASE search yielded numerous generic and irrelevant documents. To exclude these results, the EMBASE search was restricted to papers with the two concepts appearing within four words of each other. MEDLINE search yielded numerous generic results that did not report patient data. To exclude these results, the MEDLINE search was restricted to papers with the “COVID-19” and “patient” concepts appearing within four words of each other. All searches on all databases were only applied to the title, abstract, and related keyword fields. The OVID platform was used to search all databases, with the exception of CINAHL Plus, for which the EBSCOhost platform was used. Database-specific restrictions and keywords are shown in **Table 1**.

TABLE 1 | Databases and associated search queries used in all systematic searches.

CINAHL Plus	(TI cogni* OR AB cogni*) AND (TI COVID-19 OR TI COVID19 OR TI Sars-CoV-2 OR TI 2019 novel coronavirus OR TI coronavirus disease 2019)
MEDLINE	(cogni*.tw,kf.) AND (yr="2019 -Current") AND ((COVID-19 or COVID19 or Sars-CoV-2 or 2019 novel coronavirus or coronavirus disease 2019) adj4 (patient* or individual* or adult* or person* or man or woman or men or women))
EMBASE	((cogni* adj4 (COVID-19 or COVID19 or Sars-CoV-2 or 2019 novel coronavirus or coronavirus disease 2019)).ti,ab.) AND (human and english language and yr="2019 -Current")
PsycINFO	(exp Executive Function/ or exp Cognition/ or exp Cognitive Impairment/ or cogni*.mp. or exp Social Cognition/) AND (yr="2019 -Current") AND (COVID-19 or COVID19 or Sars-CoV-2 or 2019 novel coronavirus or coronavirus disease 2019)

Inclusion and Exclusion Criteria

To be included, studies were required to report either primary or secondary cognitive outcomes of SARS-CoV-2 infections confirmed by the presence of biological markers, as indicated by Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) or antibody assays, of blood, cerebrospinal fluid (CSF), or oronasopharyngeal swabs. Studies that only reported on suspected COVID-19 cases or on patients under the age of 18 were excluded, along with publications that did not report explicitly on cognitive function as characterized by reliable medical tests (e.g., CAM) or DSM-IV/V criteria. Papers in languages other than English, and papers which reported the cognitive outcomes of the socioeconomic or cultural circumstances of the COVID-19 pandemic, were also excluded. Within the included samples, data from those with cognitive impairments known or suspected to have existed prior to infection, were omitted from data analysis wherever possible. Peer-reviewed letters, case series, case-control studies, retrospective chart reviews, cohort studies, and point prevalence studies were included for analysis. Reviews, perspective/position papers, protocols/study designs, editorials, individual cases, or any non-primary sources were excluded to minimize the risks of redundant data collection and publication bias.

In compliance with the PRISMA statement (21), this review has been conducted in accordance with the PI(E)COS outline below:

- **Participants:** Patients aged ≥ 18 years with no known pre-existing cognitive impairments.
- **Intervention:** No intervention was evaluated in the present review.
- **Exposure:** SARS-CoV-2 infection confirmed by the presence of biological markers, as indicated by Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) or antibody assays, of blood, cerebrospinal fluid (CSF), or oronasopharyngeal swabs.
- **Comparator:** No overarching comparator applied to the present study, as assessments of cognitive function were categorical.

- **Outcome:** Prevalence of cognitive impairment during acute and recovery phases of COVID-19, as identified by the Confusion Assessment Method (CAM), 4 A's Test (4AT), DSM-IV/V criteria, or clinical diagnosis.
- **Studies:** Peer-reviewed case series, case-control studies, retrospective chart reviews, cohort studies, and point prevalence studies, which do not restrict selection to cognitively impaired patients.

Data Extraction Protocol

In compliance with the PRISMA statement (21), articles were assessed for relevance by title and abstract screening conducted by three independent reviewers. Full texts were examined for relevance when titles and abstracts were uninformative. Deduplication, screening, and quality assessments were conducted on the Covidence platform for systematic review management (<https://www.covidence.org/>). Conflicts in judgement were either resolved by discussion or by the judgement of the third reviewer. Throughout the review process, publications were only advanced to the next phase of examination upon the agreement of at least two reviewers. One reviewer extracted the data, and the results of these extractions were closely inspected by the co-authors.

The extracted data included: first author, year of publication, study design, sample size, sex ratio, average age, location, diagnostic test or criteria, and the prevalence of cognitive impairments. The percent prevalence of impairments and mean age of the total sample were calculated as weighted averages of the corresponding values (i.e., percent prevalence values and average age of the constituent samples, with sample sizes as weights). "Impairment" was used as a broad umbrella term that included the following conditions: altered mental status (AMS), confusion, delirium, encephalitis, encephalopathy, psychosis, dysexecutive syndrome, or any other condition explicitly reported as entailing cognitive deficits.

Methodological Quality Assessment

The quality assessment tool for case studies proposed by Murad et al. (22) was adapted to the final collection of articles of the present study. The adapted form used in the present study is presented in **Table 2**. The original tool assesses risks of bias with eight items across four domains: selection, ascertainment, causality, and reporting. Three items in the causality domain were omitted due to irrelevance; namely, the items for dose-response, challenge-rechallenge, and adequacy of time period from exposure/treatment till follow-up. Each included study was assessed by two reviewers, and conflicts were resolved by discussion. For domains in which judgments were necessarily made for separate participant subgroups, the weight of the associated domain was divided by the number of subgroups, and the sum of weights associated with items demonstrating low risk of bias was divided by the total number of items for a final quality score. Studies with scores ≤ 0.6 were considered to be at risk of being biased, and studies were ranked in accordance with this standard of quality.

TABLE 2 | Risk of bias tool used in the present study.

Selection	1. Do the patients represent the whole experience of the investigator (center) or is the selection method unclear to the extent that other patients with similar presentation may not have been reported?
Ascertainment	2. Was the exposure adequately ascertained? 3. Was the outcome adequately ascertained?
Causality	4. Were other alternative causes that may explain the observation ruled out?
Reporting	5. Is the case(s) described with sufficient details to allow other investigators to replicate the research or to allow practitioners to make inferences related to their own practice?

RESULTS

Seven studies which report on the prevalence of cognitive impairments associated with SARS-CoV-2 infection were included in this systematic review. The overall prevalence estimates from pooled and nested samples ranged from 43.0 to 66.8%, and one study demonstrated a correlation ($r = 0.557$, $p = 0.002$) between C-reactive protein (CRP) and reaction time in recovered COVID-19 patients (23). It is noteworthy that delirium was the most represented type of cognitive impairment in the prevalence estimates included. These conservative estimates along with the main findings of their associated studies, are summarized in **Table 4**.

Systematic Search Results

Due to the continuing publication of studies on COVID-19 and the scarcity of studies on cognition, databases were systematically searched at three time points: 19/07/2020, 09/08/2020, and 26/08/2020. Of 601 studies found in databases, 336 were identified as duplicates. After title and abstract screening of 266 studies, a total of 31 studies met criteria for full text assessment, which included one study found in a reference list. Of the 31, only seven met criteria for inclusion, and 24 studies were excluded for reasons listed in **Figure 1**. Six of the included studies reported the prevalence of cognitive impairment in COVID-19 patients during hospitalization, and one study (23) reported on cognitive function after recovery. The foregoing study was omitted from the total sample ($n = 644$) because the cases may not have been confirmed, and the impairments reported therein were not comparable to those in the other six studies. Nevertheless, the paper was included for its relevant findings, and because such few studies met requirements for inclusion. Notwithstanding, there was a significant lack of studies investigating the cognitive effects of SARS-CoV-2 infection. An informal search of the literature on October 11th, 2020 demonstrated that newer publications which discuss the COVID-19-cognition relationship mostly relied on the same studies found in the three formal searches of this review. Notably, Mao et al. (12) was cited often when relating infection to cognitive outcomes, but its methodological limitations necessitated its exclusion.

Quality Assessment Results

Five of the included studies had satisfactory scores above the 0.6 threshold, and two were considered unsatisfactory. The quality assessment naturally resulted in three tiers of quality: two studies had scores above 0.8, three studies had identical scores of 0.8, and two studies had identical scores of 0.6. **Table 3** lists the three tiers in order of decreasing quality, along with the domains in which each study was deemed to be methodologically lacking.

Prevalence of Neurocognitive Impairments

All data gathered from the included articles are presented in **Table 4**, which also includes summaries of study methods, major findings, and limitations. The total sample was $n = 644$ and the weighted mean of the reported average ages from its constituent samples was 69 years ($SD = 7.90$). Of this sample, at least 43.0% ($SD = 16.2$) exhibited one of the following neurocognitive impairments: delirium, confusion, AMS, encephalopathy, encephalitis, or psychosis. However, this percentage involves one study (26) which included 72 patients with premorbid dementia. Nevertheless, this study produced relevant results from models corrected for dementia in a separate analysis (reported in **Table 4**). Upon omission of this study's sample ($n = 217$), at least 49.9% ($SD = 15.8$) of the remaining pooled sample ($n = 427$) were cognitively impaired (the same neurocognitive impairments reported in the overall sample), and the weighted mean age for this sample was 64 years ($SD = 4.50$). Upon exclusion of Zhou et al. (23) and Knopp et al. (26), the percent prevalence for the combined samples of the top two tiers of quality ($n = 304$) is 53.0% ($SD = 20.6$), and the weighted mean age was 65 years ($SD = 6.01$). The types of impairment remained the same after these exclusions, with the exception of confusion; however, the more severe form of this impairment (i.e., delirium) retained its status as the most represented. The percent prevalence for the sample of the top tier alone ($n = 190$) is 66.8% ($SD = 6.57$), with weighted mean age of 61 years ($SD = 1.70$); only delirium and AMS were reported in this sample. There are additional cases of cognitive impairment that have not been incorporated into these percentages. The prevalence of some such cases along with the types of impairments as well as reports on inflammatory markers are mentioned under "Descriptions" in **Table 4**. Overall, four studies reported on inflammatory markers [C-reactive protein (CRP) or IL-6] and all four publications reported elevations in at least one of these inflammatory markers which were concomitant with cognitive impairment. Helms et al. (24) and Knopp et al. (26) reported respective elevations of IL-6 and CRP in delirious patients. Pinna et al. (25) found elevations of CRP in cases of AMS, and Zhou et al. (23) found a positive correlation between reaction time and serum (CRP) ($r = 0.557$, $p = 0.002$).

DISCUSSION

Quality of Information

One of the limitations with respect to the interpretation of the available studies was that the medications prescribed to treat COVID-19 may have significantly confounded results. As suggested in **Table 3**, four of the included studies did not exclude

confounds, the most significant of which was the dyscognitive effect of medications which may have been used to treat COVID-19 (e.g., steroids). Furthermore, much of the literature does not adequately separate cases with pre-existing neurocognitive impairments from cases of cognitive impairment associated

with COVID-19. Stringent as the inclusion criteria were, these problems still presented themselves in the included studies to varying degrees. For instance, Knopp et al. (26) did not clarify whether some of the 72 participants with pre-existing dementia were included in the delirious subgroup. Dementia and delirium

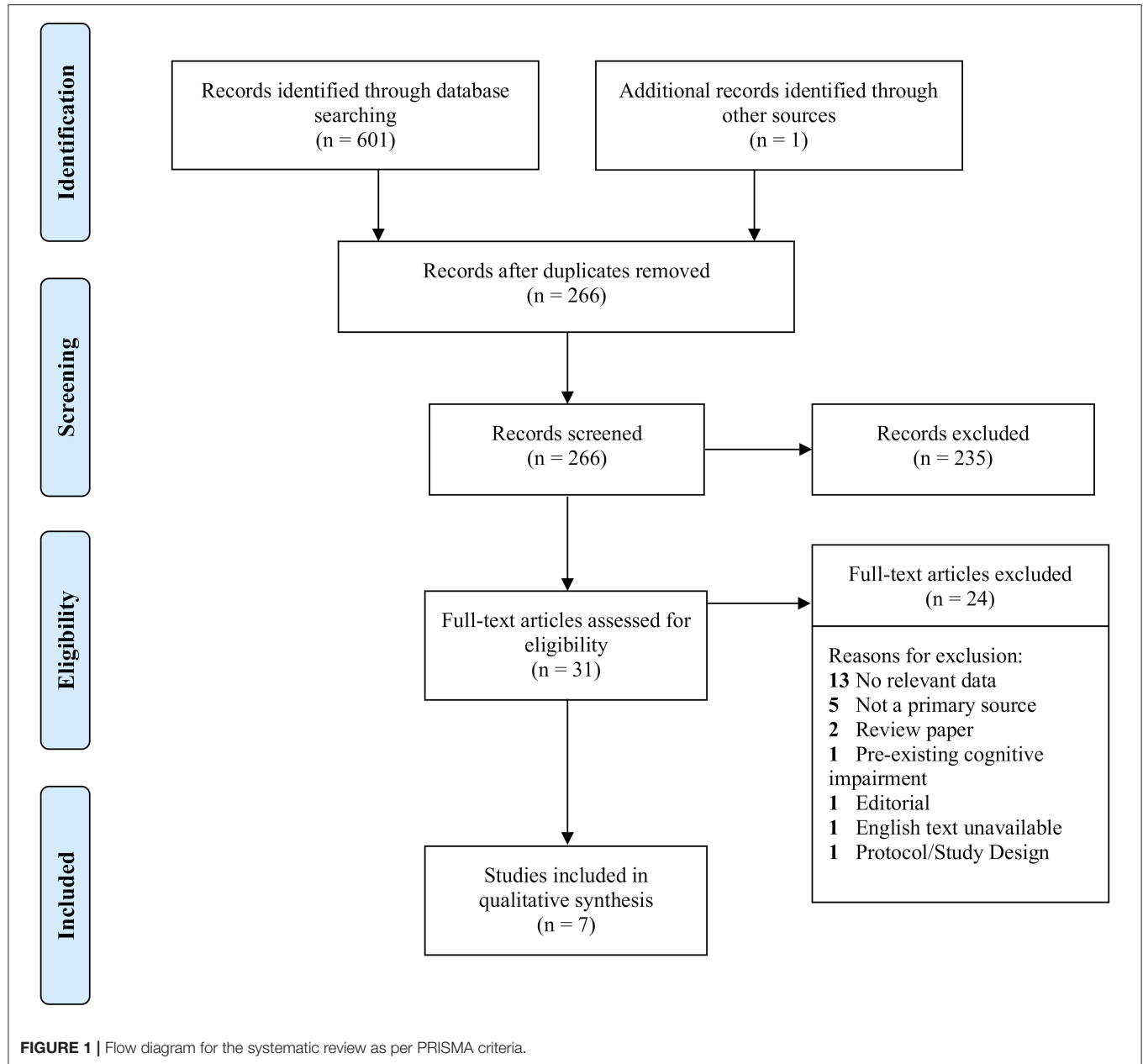


TABLE 3 | Three-tiered ranking of included studies by quality assessment score.

Study	Helms et al. (24) (B)	Pinna et al. (25)	Knopp et al. (26)	Varatharaj et al. (27)	Zhou et al. (23)	McLoughlin et al. (28)	Helms et al. (29) (A)
Quality score	1.0	0.9	0.8	0.8	0.8	0.6	0.6
High risk domain	n/a	Causality	Causality	Selection	Selection	Selection, causality	Reporting, causality

TABLE 4 | Data summaries of included publications.

Study	Design	Sample <i>N</i> (confirmed ^a)	Female <i>n</i> (%)	Age Median or Mean (range, IQR)	Location	Test	Description ^b	% Impaired ^c
Pinna et al. (25)	Retrospective chart review	50 (50)	21 (42)	59.6	Chicago, Illinois, USA	–	All cases were confirmed by RT-PCR of nasopharyngeal swabs, and the 50 cases were selected based on the availability of data on neurological status. The most common neurological feature of COVID-19 was AMS, affecting 30 patients in the sample. Twenty-four percent had cognitive abnormalities (mostly short-term memory loss), 40% had cerebrovascular issues (e.g., ischemic stroke, brain hemorrhages, transient ischemic attacks, etc.), and 26% had seizures. All reported measurements of C-reactive protein (CRP) were well above 70 mg/L. The main limitation of this study is that it does not present the extent to which these manifestations overlap in the sample, which makes it impossible to determine the number of patients with cognitive manifestations overall. It also omits all detail on the cognitive testing methods used, which makes it impossible to ascertain the effective definitions of these manifestations in context. Additionally, about half the sample exhibited neurological manifestations at least 24 h after admission, and the drugs given to this group are not listed.	60.0
Helms et al. (29) (A)	Case Series	58 (58)	–	63	Strasbourg, France	CAM, RASS	This case series includes ICU cases, all of which have been hospitalized for ARDS due to COVID-19 (confirmed by RT-PCR of nasopharyngeal swabs). Forty patients received a CAM-ICU test and 26 of them were positive for confusion/delirium. Sixty-nine percent of the total sample exhibited agitation as per the RASS, and of 39 patients tested for dysexecutive syndrome, 36% were positive. Unfortunately, only 14% of the sample were tested for neurological manifestations prior to treatment, and the paper does not specify the number of patients that exhibited cognitive symptoms in this subgroup. The sedatives used were propofol, midazolam, and sufentanil, all of which may affect cognition. Hence, the main limitation of this study is that the cognitive effects reported are confounded by treatment.	44.8
Helms et al. (24) (B)	Cohort Study	140 (140)	–	62	Strasbourg, France	CAM, RASS	The same researchers conducted a larger study to evaluate the prevalence and type of delirium seen in COVID-19 patients (confirmed as in the smaller study) in the ICU. One hundred and twenty-two of the patients were assessed for delirium with the CAM-ICU, whereas 14 died without being assessed (too sedated to respond), and four could not speak French. Of these 122 patients, 97 were positive for delirium which gives a 79.5% prevalence in ICU cases. However, a selection bias may be in effect because the unresponsive patients may have been cognitively intact prior to their deaths, so the number to the right reports a more conservative percent prevalence that includes the 18 unassessed patients. Furthermore, the authors found that 86.6% of delirious patients were hyperactive/agitated (RASS +3/+4). CSF analysis revealed inflammation in 64.3% of the assayed patients, one marker being IL-6. Twenty-two patients presented with either “delirium and/or corticospinal tract signs” at admission.	69.3
Varatharaj et al. (27)	Point Prevalence Study	153 (114)	44 (29)	71 (23–79)	United Kingdom	–	This study includes 153 COVID-19 cases, 114 of which were confirmed by PCR of nasopharyngeal swabs or CSF, or by antibodies in blood. The data to the left loosely applies to the confirmed case sample, as age and sex data were absent in many cases. Of the 114 confirmed cases, 16.6% were diagnosed with a psychiatric disorder (most of which were newly diagnosed), 12.3% were either diagnosed with psychosis or a dementia-like neurocognitive impairment, and 13.2% had either encephalitis or unspecified encephalopathy. Although most psychiatric disorders seemed to occur post-infection, they may have been undiagnosed but present prior to infection. This study does not distinguish iatrogenic effects from COVID-19 effects, and the treatments used were not described. Furthermore, a significant risk of confirmation bias is in effect because the data collection protocol was a deliberate search for neurological features of COVID-19.	29.8

(Continued)

TABLE 4 | Continued

Study	Design	Sample <i>N</i> (confirmed ^a)	Female <i>n</i> (%)	Age Median or Mean (range, IQR)	Location	Test	Description ^b	% Impaired ^c
Zhou et al. (23)	Case- Control Study	29 (0)	11 (37.9)	47.00 (30–64)	Zhejiang, China	TMT, SCT, CPT, DST	This study tested several cognitive domains in recovered COVID-19 patients vs. controls using cognitive tests* with good test-retest reliability in the Chinese population. Test scores have been shown to be affected by age, sex, ethnicity, and education level, so patient scores were compared to controls which were matched by these variables. Accordingly, criteria for all participants omitted any current or past psychiatric disorders, non-Han ethnicity, or having had <9 years of formal education. Furthermore, patients had to have at least two negative PCR results. Inflammatory markers were recorded to search for correlations with test scores. Recovered COVID-19 patients exhibited statistically significant ($P < 0.05$) reductions in items testing sustained attention, and (CRP) was correlated with CPT1 reaction time ($r = 0.557$, $p = 0.002$). The paper makes no mention of whether the patients were confirmed COVID-19 cases prior to supposed recovery, and the sample is unrepresentatively small. *[Trail Making Test (TMT), Sign Coding Test (SCT), Continuous Performance Test (CPT), Digital Span Test (DST)]	–
McLoughlin et al. (28)	Point Prevalence Study	71 (71)	20 (28.2)	61 (24–91)	London, UK	4AT, DSM- IV	This study noted all-cause mortality, delirium, and the capacity to function in normal daily life in RT-PCR confirmed COVID-19 patients. All alert/responsive patients were assessed for delirium using DSM-IV criteria, the 4AT delirium screen, and medical notes from the past 24 h. Of the 71 patients, 24 were too sedated to give meaningful responses to the 4AT. The remaining 47 were effectively assessed for delirium, and six of them had dementia. Forty-two percent of the 47 had delirium, but 63.4% ($n = 26$) of this sample had delirium when those with dementia are excluded. However, the unresponsive patients may have been cognitively intact when they were not sedated, so the number to the right reports a more conservative percent prevalence that includes these 24 patients. At 4 week follow-up, there was no significant cognitive score* difference between those who had delirium and those who did not. However, delirium was associated with poor daily functionality, which was measured by a composite score from both the NEADLS* and the Barthel Index. Finally, delirium did not predict all-cause mortality when adjusted for age, sex, and frailty. Of note, the sample was too small, and the patients involved were at varying stages of the disease progression. *TICS-m, modified Telephone Interview for Cognitive Status; NEADL, Nottingham Extended Activities of Daily Living Scale	40.0
Knopp et al. (26)	Prospective Cohort Study	217 (unknown)	83 (38)	80 (70–99, 74–85)	London, UK	–	In this study, the same group as that of the above study, aimed to quantify the same outcomes on a larger scale. In this iteration, only patients aged ≥ 70 years were included, and patients diagnosed with COVID-19 by a specialist infectious diseases team were included based on laboratory, radiological, and clinical findings, even if results for RT-PCR of oronasopharyngeal swabs were negative. Thirty-three percent ($n = 72$) of the sample had pre-existing dementia, and 29% of the sample had delirium suspected to be caused by COVID-19. The degree to which these two subgroups overlap has not been made clear, but in models adjusted for dementia, age, and other factors, delirium was associated with cognitive impairment at discharge (OR 44, 95% CI 7.4–260). Median CRP was 92 mg/L and	29.0

(Continued)

TABLE 4 | Continued

Study	Design	Sample N (confirmed ^a)	Female n (%)	Age Median or Mean (range, IQR)	Location	Test	Description ^b	% Impaired ^c
							CRP was negatively correlated with frailty. Furthermore, delirium was associated with mortality in this cohort ($p < 0.001$), unlike McLoughlin et al. (28). Similar limitations apply to these two studies, and the limitation the group seems to emphasize most is that these data have all been collected in the same hospital, allowing very little generalizability due to homogeneity of conditions.	

^aNumber of participants with confirmed COVID-19 status as per the confirmation standards outlined in the associated description.
^bAll studies report heterogeneous data from hospitalized patients at different stages of acute-phase COVID-19; the sole exception being Zhou et al. (23), which reports on recovered cases.
^cIncludes participants exhibiting altered mental status (AMS), confusion, delirium, encephalitis, encephalopathy, or psychosis; excludes patients with known pre-existing conditions that are principally characterized by cognitive impairments (e.g., dementia, mild cognitive impairment, traumatic brain injury, schizophrenia). For studies in which the overlap between these conditions was unknown, the available value which represents the most overt form of cognitive impairment was reported (i.e., delirium/confusion).

are often confused and misdiagnosed in clinical practice (30), and some evidence has suggested that patients with dementia are especially at risk of developing persistent delirium (31). This suggests that there may have been an overestimation of COVID-19 related delirium due to the inclusion of patients with dementia. There was also ambiguity in Knopp et al. (26) regarding the methods used to confirm SARS-CoV-2 infection. The article reports that these assessments were conducted by infectious disease experts but does not mention the exact methods used, or whether they were contested in the scientific literature. Nevertheless, this article was an exemplar of the fundamental challenges involved in gathering large datasets from the busy hospital environment. It is a testament to the difficulty of the situation that Knopp et al. (26) was one of the best studies available. The other included studies did allow for the exclusion of patients with known pre-existing cognitive impairments but had other significant limitations, as indicated in **Tables 3, 4**. It is likely due to such challenges that most studies did not quantify the extent of overlap between subgroups with different types of COVID-19-related cognitive impairments. In those cases, conservative prevalence statistics were produced, involving only the most severe and overt cognitive conditions (i.e., delirium).

Implicit Reporting Bias in Prevalence Results

As mentioned in “Prevalence of Neurocognitive Impairments,” the prevalence statistics produced for various combinations of the included samples ranged from 43.0 to 66.8%. Although these numbers were calculated conservatively on the study level, a reporting bias may have been amplified by pooling the results. One of the limitations of extant literature is the non-publication of negative study results. In an analysis of 64 randomly selected scientific articles, out of 145 empirically supported potential determinants of selective reporting, it was found that the leading determinant was a “focus on preferred findings,” accounting for 36% of cases (32). Despite best efforts, this review may have implicitly amplified this type of bias. It is certainly possible that some of the excluded attempts to characterize the presentations of COVID-19 involved cognitive assessments that produced negative results. Aside from bias toward preferred findings, these results may not have been reported simply for the sake of brevity. Many of the foregoing studies considered throughout this review were very broad in scope, attempting to provide a complete impression of the COVID-19 syndrome. In such cases, the omission of negative results on cognitive assessments may have seemed prudent. This implicit risk of selective reporting is difficult to rectify and is a fundamental problem in the systematic review methodology. Furthermore, the unspecified diagnostic criteria in three of the included studies may have masked loose definitions of cognitive impairment, which may have resulted in the overestimation of the associated prevalence statistics. Taking these considerations in isolation, the 43.0–66.8% prevalence range may be viewed as non-representative of the real-world prevalence of COVID-19 induced cognitive impairments. However, considering the parsimonious neurobiological models

which predict these impairments, the results included herein cannot be dismissed.

Neurobiological Model for COVID-19 Related Cognitive Impairments

As mentioned in the introduction, COVID-19 involves elevations in IL-6, TNF α (3), and IL-1 β (5), which are often exacerbated by Vitamin D3 deficiency (6). Furthermore, IL-6 and TNF α can cross the blood brain barrier and activate microglia (8). These activated cells release IL-1 β , the receptors for which are especially concentrated in the postsynaptic compartments of hippocampal neurons (33). This renders the hippocampus especially vulnerable to IL-1 β , which has been shown to disrupt long term potentiation (LTP) and memory (34). Other work has also suggested that attentional processes are subserved by hippocampal activity, demonstrating the importance of working memory in determining how attention is directed and sustained (35). Attention and working memory are among the principle cognitive functions impaired in delirium (30), and clinically manifested neurotropism may exacerbate this through additional pathways.

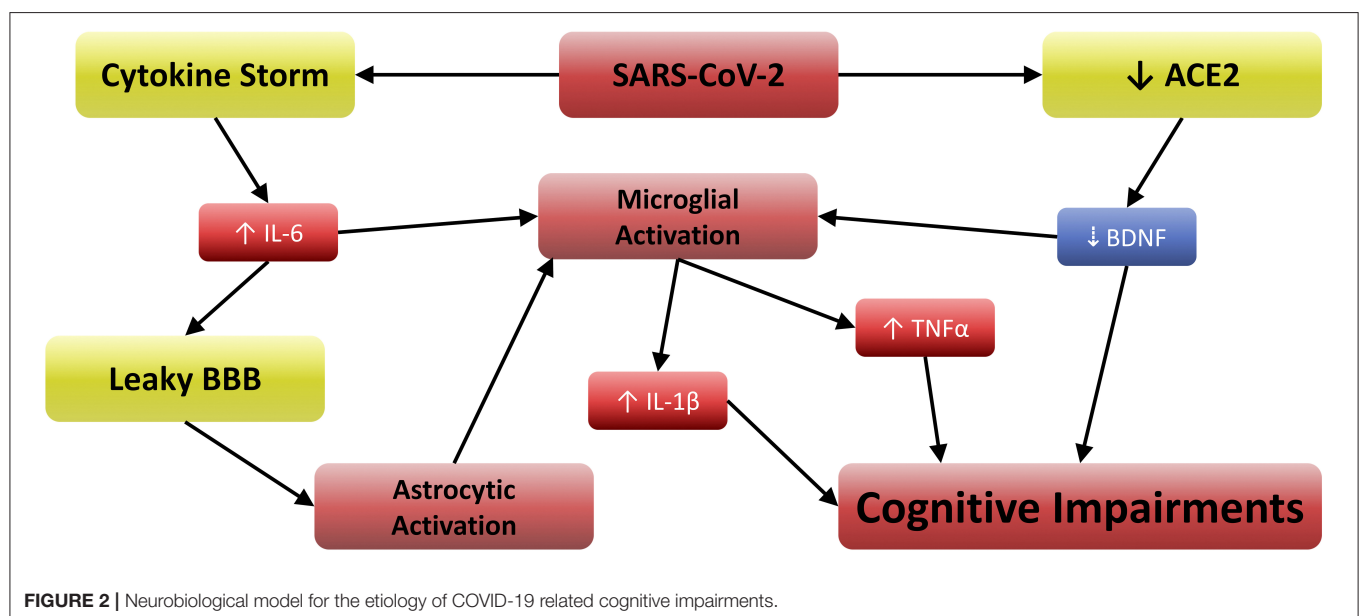
ACE2 acts as the functional and host receptor for coronaviruses (1) and regulates normal brain function by stimulating brain-derived neurotrophic factor (BDNF) activity (36). BDNF plays a critical role in attenuating microglial activation (37) and neuronal inflammation (38), and low BDNF levels are associated with cognitive impairment in both human and animal studies (37, 39, 40). SARS-CoV-2 is now known to decrease ACE2-mediated BDNF activity (20), possibly by acting as a competitive angiotensin-II-antagonist via spike protein-ACE2 binding. Regardless of the mechanism by which SARS-CoV-2 inhibits ACE2, the resulting reduction of BDNF is likely to cause cognitive impairment (20). Furthermore, the permeability of the blood-brain barrier (BBB) can be increased by

IL-6 (41), which can further microglial activation by enhancing the CNS effects of serum cytokines. Astrocytic activation also contributes to the inflammatory signal in the CNS, which is especially pronounced when BBB integrity is compromised (41). Indeed, increased BBB permeability has been observed in COVID-19 patients (26), and high CRP/IL-6 concentrations are reported by several studies (24–26).

Taken together in the context of the present study, these findings suggest that impairment of working memory and attention can both be affected by TNF α (42) and IL-1 β , because both can disrupt normal firing in the neurons involved. Furthermore, these same effects would be greater in the case of clinically manifested neurotropism. In such scenarios, it is reasonable to assume that greater proportions of the microglial and astrocytic populations would be activated due to direct toll-like receptor 3/7/8 stimulation (4), and this inflammation would be furthered by reductions in BDNF (20, 36, 39). **Figure 2** depicts the relationships between these variables, suggesting a well-supported neurobiological model for the etiology of COVID-19 related cognitive impairments. It is noteworthy that tests for delirium and other conditions provide categorical measures of cognitive outcomes, but a quantitative assessment such as that conducted in Zhou et al. (23) may aid future researchers in revealing the continuous cognitive effects of the neurobiological mechanism described herein. Furthermore, clinicians are urged to consider Vitamin D3 supplementation, as its active metabolite may attenuate such effects via reductions in TNF α and IL-1 β production (7).

LIMITATIONS

The main limitation of the analysis herein is a function of the limitations of the included studies (e.g., reported outcomes may have been confounded by iatrogenic effects). Sedatives



are often used to treat COVID-19 patients, and other drugs may also have effects on measures of cognition. For example, research has linked chloroquine and hydroxychloroquine to psychotic symptoms and irritability (43). Other studies have linked tocilizumab to headaches, dizziness, and in some cases, strokes (44). It is also important to note that the patients included for synthesis were all hospitalized, presumably due to the severity of symptoms. Accordingly, less severe COVID-19 cases may have escaped inclusion merely due to lack of adequate reporting; a possibility which restricts the generalizability of the results reported herein. Furthermore, the diagnostic tools applied to classify cognitive impairments were nebulous in three of the included studies (as suggested in **Table 4**). Theoretically, this raises concerns regarding misdiagnoses which may have exaggerated the prevalence of cognitive impairments. Aside from the risk of selective reporting explained in “Implicit Reporting Bias in Prevalence Results,” this review may also be limited by the exclusivity of the search strategy. The use of the adjacency operator on EMBASE was necessary to exclude an unmanageable number of irrelevant publications, but by applying this restriction, some relevant studies may not have been identified. Nevertheless, this review provided a quantitative assessment of cognitive dysfunction associated with COVID-19 as well as a call, for both clinical and research purposes, to apply measures of cognitive function and inflammatory markers in COVID-19 patients at presentation.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Materials**, further inquiries can be directed to the corresponding author/s.

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AUTHOR CONTRIBUTIONS

RM conceived of and supervised the project, among other contributions. RM and FN were responsible for managing the project and advising the team, among other contributions. YA, AS, and LL jointly determined the inclusion and exclusion criteria, screened the literature, formally assessed the quality of the included literature, and contributed to team discussions regarding data analysis. YA conducted the systematic searches, summarized the included literature, and wrote the first draft of the article. All authors contributed to team discussions regarding data analysis, synthesis, and interpretation and fact checked, edited, contributed to, and approved the submitted draft.

ACKNOWLEDGMENTS

Earlier drafts of this article were posted on <https://www.researchgate.net> through the first author's account. Some of these drafts did not list all authors as they were not edited and approved by the review team. Drafts were only posted for additional feedback from the online community. All drafts of this article can be viewed at: https://www.researchgate.net/publication/344622934_Impact_of_SARS-CoV-2_Infection_on_Cognitive_Functions_A_Systematic_Review.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2020.621773/full#supplementary-material>

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Conflict of Interest: YL received salary support from the Global Alliance for Chronic Diseases/Canadian Institutes of Health Research (CIHR)/National Natural Science Foundation of China's Mental Health Team Grant and the CIHR Frederick Banting and Charles Best Canada Graduate Scholarship; personal fees from Champignon Brands. RM has received research grant support from CIHR/GACD/Chinese National Natural Research Foundation; speaker/consultation fees from Lundbeck, Janssen, Purdue, Pfizer, Otsuka, Allergan, Takeda, Neurocrine, Sunovion, Minerva, Intra-Cellular, Abbvie, and Eisai. RM is a shareholder and CEO of Champignon. JR has received research grant support from the Canadian Cancer Society, Canadian Psychiatric Association, American Psychiatric Association, American Society of Psychopharmacology, University of Toronto, University Health Network Centre for Mental Health, Joseph M. West Family Memorial Fund and Timeposters Fellowship and industry funding for speaker/consultation/research fees from Allergan, Lundbeck and COMPASS. JR is the medical director of a private clinic providing off-label ketamine infusions for depression.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Depression Following COVID-19 Lockdown in Severely, Moderately, and Mildly Impacted Areas in China

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OPEN ACCESS

Edited by:

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University of Otago, New Zealand

Reviewed by:

Carlo Lai,
Sapienza University of Rome, Italy
Frederick Sundram,
The University of Auckland,
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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 20 August 2020

Accepted: 29 January 2021

Published: 19 February 2021

Citation:

Han X, Chen S, Bi K, Yang Z and
Sun P (2021) Depression Following
COVID-19 Lockdown in Severely,
Moderately, and Mildly Impacted
Areas in China.
Front. Psychiatry 12:596872.
doi: 10.3389/fpsy.2021.596872

Background: The Coronavirus Disease 2019 (COVID-19) pandemic has led to overwhelming levels of distress as it spread rapidly from Wuhan, Hubei province to other regions in China. To contain the transmission of COVID-19, China has executed strict lockdown and quarantine policies, particularly in provinces with the highest severity (i.e., Hubei). Although the challenges faced by individuals across provinces may share some similarities, it remains unknown as to whether and how the severity of COVID-19 is related to elevation in depression.

Methods: The present study compared depression among individuals who lived in mildly, moderately, and severely impacted provinces in China following the lockdown ($N = 1,200$) to norm data obtained from a representative sample within the same provinces in 2016 ($N = 950$), and examined demographic correlates of depression in 2020.

Results: Residents in 2020, particularly those living in more heavily impacted provinces, reported increased levels of depression than the 2016 sample. Subsequent analyses of sub-dimensions of depression replicated the findings for depressed mood but not for positive affect, as the latter only declined among residents in the most severely impacted area. Increased depressed mood was associated with female, younger age, fewer years of education, and being furloughed from work, whereas reduced positive affect was associated with younger age and fewer years of education only.

Conclusions: This study underscored the impact of COVID-19 on depression and suggested individual characteristics that may warrant attention.

Keywords: exposure, stress, lockdown, COVID-19, depression

INTRODUCTION

In December 2019, an unknown and infectious disease broke out in Wuhan, China, which was declared a pandemic by the World Health Organization (1) and officially referred to as the Coronavirus Disease 2019 (COVID-19) on February 11th, 2020. Since then, it has taken a tremendous toll on individuals, families, and communities, infecting and claiming millions of lives worldwide (2). In addition to adapting to a new reality dominated by fear of viral contagion as well as social isolation due to lockdown and quarantine, individuals have experienced devastating losses in multiple domains of life. The long-term effects may extend further than the duration of

the lockdowns. As individuals start to seek reemployment and a return to normal life, depressive symptoms may emerge as feelings of sadness and loss grow beyond fear and anxiety, when they realize that normality continues to remain elusive. The present study aims to compare depressive symptoms among Chinese residents in provinces that were severely, moderately, mildly hit by the pandemic in early May of 2020 with pre-pandemic norm and identify demographic correlates of depression after the lockdown.

Elevated Psychological Distress Amidst the Outbreak of COVID-19

COVID-19 is particularly disruptive as it imposes widespread and severe restrictions without a certain end date, presents a complex combination of stressful life events, and blocks access to protective factors (3).

Fear of contracting the virus is probably one unique stressor that the COVID-19 has imposed on individuals. Over one-third of respondents expressed increased concern and excessive anxiety about viral infection, even when the risk was estimated to be low in early 2020 (4). Loss due to COVID-19 can range in severity and duration, be direct (i.e., infection) or indirect [i.e., child mortality in low-income countries; Robertson et al. (5)], present-oriented (i.e., unemployment), or future-oriented (i.e., uncertainty of academic progression) and on the individual (i.e., increased psychological distress), or the collective (i.e., an overstretched medical system) level, resulting in varying elevation in psychological distress. Another ramification of COVID-19 is an increase in the feelings of disgust toward outgroups that are believed to pose an elevated risk of infection (6). Disease avoidance arises from people's evolutionary tendency to maintain health (7), but it unfortunately contributes to prejudice against national subgroups (i.e., the residents of Hubei Province, China). Hubei residents encountered increasing social exclusion and stigmatization in forms of in-person verbal assault, destruction of property, being denied employment opportunities or access to public facilities and a general violation of fairness (8). Given that the adverse impact of discrimination on people's mental health has been well-documented (9), it is possible that levels of depression in Hubei residents might be further aggravated by such experiences.

Depression Following the Lockdown

COVID-19 led to unprecedented policies of quarantine in an attempt to contain the pandemic, starting with Wuhan in Hubei Province. Enforced by government and community officials, stringent lockdown measures prohibited residents from leaving the city, restricted each household to send one person to purchase groceries twice a week, and banned the private use of cars (10). To further limit group activities, the local government also took steps to reward individuals who reported neighbors breaking social distancing rules (10). Inevitably, mandatory quarantine generated common challenges such as working from home while balancing childcare, experiencing wage loss, and lacking food supplies, and clashed with the fundamental human need for connection and belonging (11). Forced social isolation reduced social and physical contacts with others, thereby generating

elevated depressed mood, emotional disturbance, boredom, frustration, and blocking access to effective coping strategies such as seeking social support (12, 13).

Stress Exposure: Severely, Moderately, and Mildly Impacted Areas

In the current literature, a number of studies have investigated the association between combat exposure and the prevalence of PTSD and mood disorders, provided that exposure to trauma is positively related to the severity of symptoms (14–16). Other studies have followed to suggest that the magnitude of exposure to a variety of adverse events, including natural disasters (17), childhood maltreatment (18), and racism (9) is associated with subsequent depressive symptoms and overall maladjustment (17). Studies on different epidemics, including COVID-19, the severe acute respiratory syndrome (SARS), and Middle East respiratory syndrome (MERS), reached same conclusions that the level of disease exposure was a substantial risk factor for developing psychological problems (19). Specifically, health care workers or employees in high-exposure-risk locations (i.e., Wuhan vs. other cities in Hubei province vs. outside Hubei province) were significantly more likely to exhibit symptoms of depression, anxiety, distress, insomnia (20), and PTSD symptoms (21). Therefore, it is reasonable to suspect that different patterns of mental health issues existed across provinces that were exposed to COVID-19 to different degrees.

One way to determine the severity of exposure for each province is calculating the infection rate. Specifically, the provincial number of COVID-19 cases was divided by the total number of regular residents (in millions) for each province, using the government census data. The infection rate, ranging from 2.99 to 1,151.41, was utilized as an index to compare severity and categorize all regions into mildly impacted (MiA, i.e., 2.99–9.03), moderately impacted (MoA, i.e., 12.24–27.53), and severely impacted areas (SeA, 1,151.41). By May 10th, 2020, Hubei province is considered the highest in severity with an infection index of 1,151.41 to represent SeA. For MoA, Guangdong and Zhejiang provinces were chosen, with 22.10 and 14.00 per million residents contracting the virus. Shanxi and Sichuan represented MiA, since both provinces had lower infection indexes of 5.33 and 6.73, respectively. Hubei, Guangdong, Zhejiang, Sichuan, and Shanxi provinces are geographically proximate.

Demographics Correlates of Depression Following the Lockdown

Recent research has identified potential correlates such as younger age, being single, fewer years of education, female gender, student status, pre-existing physical symptoms, and poor perceived general health (22–24). In an attempt to replicate previous findings and generate novel explanations, we included not only gender, age, years of education attained, and marital status, but also annual income and changes in work or wage resulting from disruptions caused by COVID-19 into the analysis. To our knowledge, these two factors were rarely discussed in combination. Early works showed that unemployment and economic insecurity had detrimental effects

on one's self-rated health and psychological health both short-term and long-term (25–27). Following the Great Economic Regression from 2007 to 2009, recession-related stressors such as increased debt, reduced budget, unemployment, and inability to pay rent, were associated with higher odds of developing depression, generalized anxiety, panic, substance use even years later (28). Similarly, Wilson et al. (29) have found that increased job insecurity and financial concerns were differentially associated with heightened depressive and anxious symptoms. Brooks et al. (12) have proposed that individuals with lower annual income prior to the pandemic might be more affected by financial uncertainties and require additional support than those with higher income. Taking both income level and change in employment status into account, we intended to investigate which factor was more strongly related to increased depression in face of COVID-19. The majority of research on COVID-19 has used univariate analyses to explore these relationships, whereas our study conducted multivariate analyses with a forward stepwise procedure (30), which could provide information on the significance of the relationships and the size of the effects as well as the structure and the interaction effect of multiple covariates while adjusting for potential confounding factors (31).

The Current Investigation

The current investigation aims to compare depression along with its two subdimensions, measured by the Center for Epidemiological Studies – Depression (CES-D) scale among residents living in mildly, moderately, and severely impacted provinces in 2020 and norm data in 2016. In addition, we investigated how potential demographic factors relate to depression. Taken together, we proposed the following hypotheses: (1) Residents in 2020 would exhibit greater levels of depression than residents in 2016. (2) Among residents surveyed in 2020, those living in SeA would exhibit the highest levels of depression, followed by those living in MoA, followed by those living in MiA. (3) Following the lockdown, those who were female, furloughed, or achieved lower levels of education and income would exhibit greater levels of depression than their counterparts. The other demographic factors examined were exploratory in nature, including age (i.e., while age was often perceived to be negatively correlated with depression, the elderly might have suffered the most during the pandemic) and marital status (i.e., although this factor was often discussed, research results were inconsistent).

METHODS

Participants and Data

To capture levels of depression prior to COVID-19, depression norm data collected in 2016 from the China Family Panel Studies [CFPS; (32)], a nationally representative survey of Chinese communities, families, and individuals, was obtained. CFPS is conducted by the Institute of Social Science Survey (32) of Peking University, China, attempting to provide a comprehensive overview of the citizen's health, mental well-being, educational attainment, family income, parental practices, social relationships, and others. CFPS collects data every 2 years,

and the most recent data set was sampled in 2018. Nonetheless, it did not measure the 20-item CES-D scale and could not be used. Instead, the openly available 2016 data set included the CES-D 20-item scale and served as the baseline depression norm, which is comparable to those of two other Chinese studies (33, 34). Eligibility criteria included age between 18 and 65, responding to all 20 items on the CES-D scale, and living in Hubei, Guangdong, Zhejiang, Sichuan, or Shanxi at the time when the survey was taken. Data were collected in person, through the phone, or using the internet. Participants who did not comply with data collection (e.g., invariance of response or non-compliance) were excluded.

All participants in the 2020 sample were recruited simultaneously from May 10 to 20, 2020, adopting the same eligibility criteria. The study was launched using the Questionnaire Star, a Chinese survey platform that facilitates high-quality data collection. A link to the survey was disseminated via popular social media platforms such as Wechat, Weibo, and Zhihu. Participation was voluntary and anonymous. Respondents were debriefed about the nature and aim of the study and gave informed consent. This study was approved by the Institutional Review Board (IRB) at the Department of Psychology, XXX (Masked for blind review) University.

Measures

The survey consisted of demographic information and depression scores. Participants were asked to report their age, gender, education level, marital status, their annual individual income prior to COVID-19 and changes in their employment and income status (i.e., “Decreased income,” “No change in income,” “Increased income,” “Being furloughed,” “No employment”) at the time of the survey. Gender (female = 0, male = 1), marital status (single = 1), income change (furlough, decreased income = 1) were dummy coded. The reduced wage was coded together with being furloughed to capture the negative effects of COVID-19 on individuals' or familial financial capacities. In the 2020 data, provinces were coded according to the severity of exposure, with Hubei Province being 3, Guangdong and Zhejiang being 2, and Sichuan and Shanxi being 1.

Depression was measured with the 20-item CES-D scale (35), which captured an individual's level of depression and the frequency of thoughts or behaviors during the past week and used a three-point scale from 0 (< 1 day a week) to 3 (5–7 days a week). The total score ranged from 0 to 60, with a higher rating indicating a more severe presentation of depression. Although Radloff's (35) original work supported a four-factor model of CES-D (i.e., depressed affect, positive affect, somatic and retarded activity, and interpersonal factor), the current investigation adopted a two-factor model to avoid potential over-extraction (36). The two factors were relevant to the wording of the items as four of them were positively valenced and the remaining negatively valenced (37). Factor *positive emotion* included item 4, 8, 12, and 16, and the remaining items summed to reflect the second factor *depressed mood*.

Analytic Plan

All statistical analyses were performed in R (38) via *glm* in base R, and *pequod*, *huge*, *car*, *tidyverse*, *lm.beta*, *lme4*, *WRS* packages. To investigate the significance of differences in scores obtained from CES-D among the four groups (2016 and Mildly, Moderately, and Severely Impacted Areas in 2020) categorized by the levels of severity at which an area was hit by COVID-19, analysis of variance (ANOVA) or its variant would be applied after the assumptions of equal variance and normality were tested.

To explore the relationship between demographic factors and depression, depressed mood, and positive affect in 2020, three hierarchical multiple regression models were built. Standardized coefficients (β) were provided for regression analyses. Simple slope analysis (39, 40) was conducted on interaction effects to reveal the nature of significant interactions and detect relations between predictors and outcomes at different levels of the moderator with increased sensitivity (41). Compared to the test of interaction effect in a regression model, a test of simple slopes has increased power regardless of the interaction term's significance and decreased likelihood of Type II error, while maintaining an equivalent level of Type I error (41). Severity was set as the moderator for all analysis with each slope assessed at "low" (1 SD below the mean) and "high" (1 SD above the mean) levels of severity.

RESULTS

From the complete CFPS 2016 data set, a total of 950 respondents at their middle age ($M = 43.33$, $SD = 13.57$) were included for the calculation of norm and final analysis. The majority of respondents were women (54.8%), married, divorced, or widowed (87.1%), and attended high school education or less (80.4%).

For the 2020 sample, 1,200 participants at their middle age ($M = 31.18$, $SD = 11.59$) were eligible for final analyses. The sample size was moderate across Hubei ($N = 300$, Age: $M = 29.26$, $SD = 9.99$), Guangdong ($N = 199$, Age: $M = 28.82$, $SD = 8.40$), Zhejiang ($N = 201$, Age: $M = 28.37$, $SD = 10.24$), from Sichuan ($N = 249$, Age: $M = 27.51$, $SD = 8.89$), and Shanxi ($N = 251$, Age: $M = 41.26$, $SD = 13.27$). Among them, a majority were women (64.1%), single or never married (53.1%), had a master's degree or less (86.2%), an annual income of 50,000 CNY or less (48.2%), and did not report changes in their work or income status (23.6%).

Change in Depression From 2016 to 2020

At the traditional CES-D cutoff value of 16 (35), which proposes that people who score equal to or above 16 are at risk for clinical depression, the relation between these variables was significant, $X^2(1, N = 2,150) = 112.87$, $p < 0.001$, and 29, 44, 49, and 54% residents met this criterion of depression in 2016, MiA, MoA, and SeA, respectively. Following the recommendations of Vilagut and colleagues (42) who proposed 20 as a better cutoff point, the relation was still significant, $X^2(1, N = 2,150) = 97.95$, $p < 0.001$, and 16, 32, 35, and 40% residents met this criterion of depression in 2016, MiA, MoA, and SeA, respectively.

As the data collected violated the assumptions (i.e., assumption of normality and equal variances) of traditional ANOVA, robust ANOVAs and robust *post-hoc* tests based on bootstrapping and trimmed means were chosen, as they could yield more accurate results when assumptions are not met (43). In total, three one-way robust ANOVAs were specified to evaluate the differences among four groups on total depression score, depressed mood, and positive emotion (Table 1 and Figure 1).

A robust ANOVA examining possible differences among the four groups was significant, $F_t = 45.15$, $p < 0.001$, indicating that some groups reported elevated levels of depression than others. The results of robust *post-hoc* tests were all significant except for the comparisons between the scores of residents who lived in MoA and those of residents who lived in SeA, $p = 0.10$ and between MiA and MoA, $p = 0.14$. Notably, the robust *post-hoc* comparisons revealed that the residents in 2016 were significantly less depressed than those of residents living MiA, $p < 0.001$, Hedges' $g = 0.45$, MoA, $p < 0.001$, Hedges' $g = 0.58$, and SeA, $p < 0.001$, Hedges' $g = 0.75$, in 2020.

The second robust ANOVA revealed significant differences across groups in depressed mood, $F_t = 61.65$, $p < 0.001$. The results of robust *post-hoc* tests were almost always consistent with the previous *post-hoc* test on total depression: all results were significant except for the comparison between MoA and SeA, $p = 0.16$. Residents assessed in 2016 exhibited significantly lower levels of depressed mood than those in MiA, $p < 0.001$, Hedges' $g = 0.56$, MoA, $p < 0.001$, Hedges' $g = 0.66$, and SeA, $p < 0.001$, Hedges' $g = 0.80$, in 2020.

A final robust ANOVA on positive emotion also yielded a significant result, $F_t = 7.39$, $p < 0.001$, indicating that some groups experienced lower positive mood. The results of *post-hoc* tests, however, revealed a different pattern. Residents in SeA exhibited reduced positive mood than all other groups, $p.s. < 0.01$, Hedges' $g.s. < -0.21$. The level of positive emotions of residents in MoA and MiA in 2020 were not statistically different from those of residents assessed in 2016.

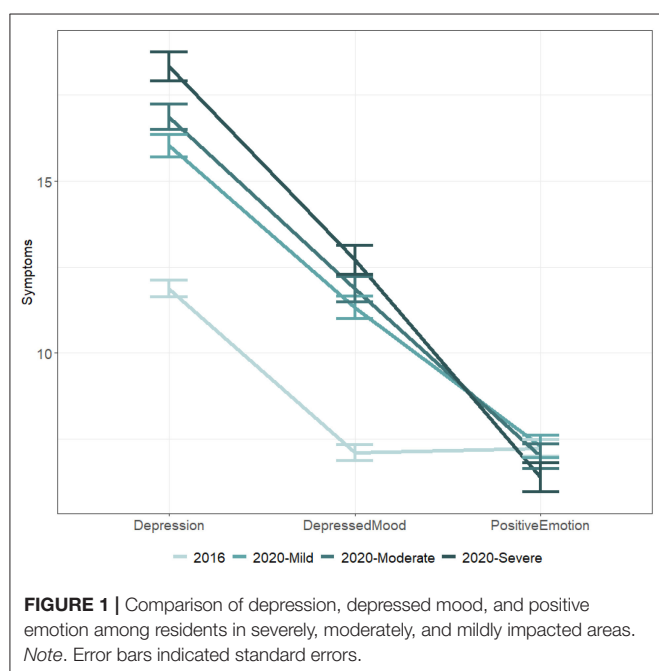
Symptom Variability Within 2020

For the total score of *depression* (Table 2), in step 1, age was found negatively associated with depression, $\beta = -0.21$, $t_{(1197)} = -7.36$, $p < 0.001$. In step 2, main effects of educational attainment, marital status, income level, and income change due to COVID-19 were included. As expected, a negative relationship between education and depression was found, $\beta = -0.09$, $t_{(1178)} = -3.14$, $p = 0.002$. Moreover, the experience of being furloughed was significantly associated with increased depression, $\beta = 0.11$, $t_{(1178)} = 3.62$, $p < 0.001$. Severity of COVID-19 was included to the model in step 3, but there was no evidence supporting the link between provincial severity of COVID and depression, $\beta = 0.04$, $t_{(1177)} = 1.53$, $p = 0.13$. In step 4, six two-way interaction terms, between gender and severity, age and severity, education and severity, being single and severity, income and severity, and being furloughed and severity were included. Among them, only the one between gender and severity was significant, $\beta = -0.19$, $t_{(1171)} = -2.53$, $p = 0.01$. Simple slope analyses were performed. Compared to men, women were more

TABLE 1 | Depression in Residents Assessed in 2016, MiA, MoA, and SeA and Symptom Comparisons.

Symptoms		Depression		Depressed mood		Positive emotion	
<i>M</i> (<i>SD</i>)	Range	[0 60]		[0 48]		[0 12]	
	2016	11.9 (7.82)		7.09 (6.37)		7.23 (2.78)	
	MiA	16.0 (11.1)		11.3 (9.37)		7.28 (3.12)	
	MoA	16.9 (10.3)		11.8 (8.58)		6.99 (2.99)	
	SeA	18.3 (10.4)		12.7 (8.85)		6.38 (2.77)	
		Hedges' <i>g</i>	<i>p</i>	Hedges' <i>g</i>	<i>p</i>	Hedges' <i>g</i>	<i>p</i>
Symptom comparisons	2016<MiA	0.45	<0.001	0.56	<0.001	0.02	0.41
	2016<MoA	0.58	<0.001	0.66	<0.001	−0.08	0.17
	2016<SeA	0.75	<0.001	0.80	<0.001	−0.31	<0.001
	MiA<MoA	0.08	0.14	0.05	<0.05	−0.09	0.17
	MiA<SeA	0.21	<0.01	0.15	<0.01	−0.30	<0.001
	MoA<SeA	0.14	0.10	0.10	0.16	−0.21	<0.01

(1) 2016 = Baseline Depression Norm (*N* = 950). MiA, Mildly Impacted Areas (*N* = 500); MoA, Moderately Impacted Areas (*N* = 400); SeA, Severely Impacted Area (*N* = 300). (2) Hedges' *g* values are considered large, medium, and small at 0.80, 0.50, and 0.20. (3) Bolded *p*-values are considered significant after robust post-hoc tests based on trimmed means and bootstrapping with false discovery rate set to be 0.05.



likely to experience depression when the severity was high, $B = -2.67$, $p = 0.006$, but not when the severity was low, $B = -0.09$, $p = 0.92$. The marginally significant interaction effect between education and severity, $\beta = 0.57$, $t_{(1171)} = 1.95$, $p = 0.05$, was also tested. The slope was significantly different than zero at a low level of severity, $B = -0.90$, $t_{(1171)} = -3.53$, $p < 0.001$, yet insignificant at a high level of severity, $B = -0.15$, $t_{(1171)} = -0.60$, $p = 0.55$, suggesting that only in provinces that were less severely impacted, as years of education increased, the total CES-D score decreased.

Similar findings emerged for **depressed mood** (Table 2). In step 1, both gender, $\beta = -0.06$, $t_{(1197)} = -2.12$, $p = 0.03$, and

age, $\beta = -0.22$, $t_{(1197)} = -7.95$, $p < 0.001$, were significantly related to changes in depressed mood. In step 2, educational level, $\beta = -0.07$, $t_{(1178)} = -2.39$, $p = 0.02$, was negatively associated with depressed mood, while being furloughed, $\beta = 0.11$, $t_{(1178)} = 3.76$, $p < 0.001$, was positively associated with depressed mood. In step 3, severity was not related to changes in depressed mood, $\beta = 0.01$, $t_{(1177)} = 0.39$, $p = 0.70$. In step 4, only the interaction between gender and severity demonstrated a meaningful relationship to depressed mood, $\beta = -0.19$, $t_{(1171)} = -2.57$, $p = 0.01$, whereas the interaction between education level and severity was marginally significant, $\beta = 0.51$, $t_{(1171)} = 1.72$, $p = 0.09$. Therefore, simple slope analyses were performed to reveal the nature of interaction. Comparable to depression, females who lived in more severely impacted regions experienced increased depressed mood compared to males, $B = -2.73$, $t_{(1171)} = -3.37$, $p < 0.001$, but not when they lived in less severely impacted areas, $B = -0.45$, $t_{(1171)} = -0.60$, $p = 0.55$. Education, again, was a significant predictor of depressed mood only when severity was low, $B = -0.60$, $t_{(1171)} = -2.77$, $p = 0.006$, but not when severity was high, $B = 0.008$, $t_{(1171)} = 0.04$, $p = 0.97$.

Age was positively associated with **positive emotions** (Table 2), $\beta = 0.07$, $t_{(1197)} = 2.50$, $p = 0.01$. In step 2, there was strong evidence that more years of education were associated with greater positive emotion, $\beta = 0.12$, $t_{(1178)} = 3.99$, $p < 0.001$. Neither income nor being furloughed was significant. In step 3, results demonstrated that, as severity increased, positive emotion decreased, $\beta = -0.12$, $t_{(1177)} = -4.23$, $p < 0.001$. In the last step, the final model supported the significance of education, single status, $p.s. < 0.05$, and the marginal significance of the interaction effect between educational attainment and severity, $\beta = -0.52$, $t_{(1171)} = -1.76$, $p = 0.08$. Well-educated individuals were less susceptible to a drop in positive emotion in both less and more severely affected regions, though the slope at low severity, $B = 0.30$, $t_{(1171)} = 4.30$, $p < 0.001$, was steeper and

TABLE 2 | Standardized regression coefficients and accounted variances for hierarchical multiple regression.

	CESD - Total depression				CESD - Depressed mood				CESD - Positive emotion			
	Step 1	Step 2	Step 3	Step 4	Step 1	Step 2	Step 3	Step 4	Step 1	Step 2	Step 3	Step 4
Age	-0.21***	-0.17***	-0.16***	-0.13	-0.22***	-0.20***	-0.20***	-0.15	0.07*	0.02	-0.01	0.02
Gender	-0.04	-0.04	0.04	0.14+	-0.06*	-0.06*	-0.06*	0.12	-0.03	-0.03	-0.04	-0.14+
Years of education (YoE)		-0.09**	-0.10***	-0.23**		-0.07*	-0.07*	-0.20**		0.12***	0.13***	0.25**
Single (dummy coded)		0.07	0.07	0.24*		0.05	0.05	0.20+		-0.09+	-0.10*	-0.25*
Income		-0.02	-0.03	0.01		-0.02	-0.02	0.01		0.03	0.04	-0.003
Furlough (dummy coded)		0.11***	0.10***	0.16*		0.11***	0.11***	0.16*		-0.05	-0.05	-0.10
Severity			0.04	-0.34			0.01	-0.30			-0.12***	0.32
Age × severity				-0.009				-0.04				-0.08
Gender × severity				-0.19*				-0.19*				0.10
YoE × severity				0.57+				0.51+				-0.52+
Single × severity				-0.18				-0.16				0.16
Income × severity				-0.04				-0.03				0.05
Furlough × severity				-0.06				-0.05				0.05
R ²	0.047	0.07	0.072	0.083	0.057	0.075	0.075	0.085	0.006	0.03	0.044	0.052
Adjusted R ²	0.046	0.065	0.067	0.073	0.056	0.07	0.07	0.075	0.004	0.025	0.039	0.041
Residual Std. error	10.464 (df = 1,197)	10.363 (df = 1,178)	10.357 (df = 1,177)	10.320 (df = 1,171)	8.738 (df = 1,197)	8.677 (df = 1,178)	8.680 (df = 1,177)	8.655 (df = 1,171)	3.003 (df = 1,197)	2.977 (df = 1,178)	2.955 (df = 1,177)	2.951 (df = 1,171)
F-statistic	29.776*** (df = 2; 1,197)	14.822*** (df = 6; 1,178)	13.055*** (df = 7; 1,177)	8.190*** (df = 13; 1,171)	36.279*** (df = 2; 1,197)	15.908*** (df = 6; 1,178)	13.647*** (df = 7; 1,177)	8.385*** (df = 13; 1,171)	3.421** (df = 2; 1,197)	6.003*** (df = 6; 1,178)	7.780*** (df = 7; 1,177)	4.935*** (df = 13; 1,171)

Note: +, $p < 0.10$; *, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$.

signified a greater power than the slope at high severity, $B = 0.16$, $t_{(1171)} = 2.26$, $p = 0.02$.

DISCUSSION

Amid the global outbreak of COVID-19, individuals may experience increased distress.

In accordance with the first hypothesis, participants recruited in the early May of 2020 reported greater severity of depression as compared with a pre-pandemic norm established using representative samples in 2016. It should be noted that there were age differences and that the simple manipulation of limiting the sample to an age range (i.e., 18–65) could not guarantee the equivalence of central measures between these groups. Within in the 2020 sample, elevation of symptoms differed significantly from MiA, to SeA, determined by the provincial infection rates. Our results have provided confirming evidence for the second hypothesis as well as previous studies suggesting that increased exposure to COVID-19 through location, media, or infected cases predicted mental health problems (44). High levels of depression may also reflect comorbid anxiety, posttraumatic stress disorder, sleep disorder, suicidal ideation, domestic violence, substance use disorder as tested in other studies, and potentiate long-term consequences like cognitive impairments, psychosomatic symptoms, and behavioral changes (45).

Depressed mood, like the total level of depression, was higher in 2020 and positively associated with the severity of COVID-19. Findings from the robust ANOVA confirmed that people facing COVID-19 experienced a significantly higher degree of

depressed mood, which was intensified by increased exposure to COVID-19, as symptoms were significantly lower in MiA than MoA and SeA.

A separate pattern emerged for positive emotion, which did not differ among the baseline norm, MiA, and MoA. Only residents of SeA had significant impairments in positive emotion when compared to the other three groups. Perceived discrimination may partly account for this observation, since according media only residents of Hubei (i.e., SeA) reported various forms of prejudice. Previous studies have established a relationship between perceived discrimination and alterations in affect, especially in stressful situations like the current one (46). One way to explain the distinct pattern emerged for positive emotion could be that the pandemic primarily exerted its negative impact through aggravating depressed mood without necessarily reducing positive affect.

Demographic Correlates

Age and Marital Status

In the 2020 sample, people who were younger and single were affected more heavily by COVID-19 and more likely to have depression. People who were older reported lower levels of depressed mood and higher levels of positive emotions. Marital status was not associated with depressed mood or positive mood in our study.

In regard to age, Qiu et al. (23) showed that individuals between the ages of 18 and 30 or above 60 had the highest level of distress, recognizing that young people were more susceptible to stress-inducing information on social media and

individuals older than 60 were more likely to feel threatened by the high mortality rate of COVID-19 among elderly. Our findings have partly confirmed their results, as younger individuals in the current sample were more likely to be depressed, have depressed mood, or to experience decreased positive emotions. First, young and single individuals had easy access to social media platforms, were more motivated to seek health, informational, and social support online, and more likely to get overwhelmed by the combination of accurate and faulty information (47). Second, they were more likely to quarantine alone and fared the worst with greater levels of future uncertainty in terms of academic and career progression (24). Third, higher levels of loneliness, financial distress, sleep problems, perceived stress and anxiety, and lower resilient coping were found among the younger population, compared to the older population (48). Furthermore, prior studies regarding SARS in 2003 have underscored the interplay between infection control measures, like wearing a mask and confinement within the home, to reinforce a sense of isolation (49) and subjective loneliness (50), which typically differed from an active lifestyle brimmed with vigor and gregariousness. A dramatic and enforced change in the frequency of social interactions and lonely feelings exerted detrimental effects on health, including impaired functionality, perceived decline in life quality and self-rated health (50).

Gender

Inconsistent with parts of the third hypothesis, gender was marginally significantly associated with depressed mood, but not with depression or positive emotion. Female participants reported higher levels of depressed mood as compared to their male counterparts. Our findings were partly consistent with relevant studies which proposed that females had a greater risk for depression, anxiety, and stress across nations during the pandemic, although these studies did not specify any subdimensions of depression (51–53). Gender differences in depression have been long established, looking at this issue through biological, psychological and social lenses (54). Under the unique circumstances of a global pandemic, the quarantine order might have led to forced and unwanted proximity with others, exposing women to escalated relationship difficulties or interpersonal problems. In extreme cases, rates of domestic violence grew as tensions built at home and victims were involuntarily confined with their abusers (55). It also pushed women to accept an overload of roles within the household and outside of it while adjusting to additional responsibilities (54).

Educational Attainment

Unlike other research in which the effect of education has been inconsistent (22–24), we validated parts of the third hypothesis concerning the effect of education and found that more years of education were promising in decreasing depression, depressed mood, and increasing positive emotions. Education could protect against both persistent sadness and anhedonia or diminished positive affect. Education may prove useful when dealing with stressful life events, thereby decreasing the likelihood of lifetime depression (56–58). Another potential explanation could be that individuals with lower levels of education were often subject

to a furlough or a permanent layoff at times of an economic recession (59).

Employment and Income

The individual income level prior to the pandemic was not associated with depression, depressed mood, or positive emotions. Results contradicted our hypothesis and previous research (12). For example, Ettman et al. (59) saw a higher prevalence of financial stressors and probable depression in people with fewer assets, defined by household income, savings, house ownership, education, and being married. Another study reported that families with lower income levels had elevated symptoms of depression, anxiety, insomnia, and acute stress across various regions in China (60). On the contrary, high monthly income was found to be a risk factor for depression, anxiety, and sleep disorder by Wenning et al. (61). Discrepancies in conclusions may suggest a complex picture of the relationship between income, financial assets, and risk of depression, possibly mediated by geographical location, parental financial support, and culture-specific spending and saving practices. Geographical location determines a city's level of urbanization, the proportion of migrant workers, and living or rental housing unaffordability issues (62). Even though household income was generally higher in the first-tier cities, individuals, especially migrant workers, faced the reality of high rent stress (i.e., with a rent-to-income ratio going up to 50% in some cities), spatial inequality, and uncertainty due to short-term lease contracts (63). Parental financial support might be a potential confounder in our study, considering that we measured individual income per year without taking parental contribution into account. In light of the traditional values that held interdependence in high regard, Chinese parents are typically more determined to support their children financially until the children bear the role of a supporter (64). Moreover, with a high national savings rate of 59% in 2012 (65), the Chinese samples might have more savings in immediate possession, allowing even low-income individuals to endure the situation. These factors complicated the meaning of income and should be disentangled before unveiling the true nature of how income level associated with depression during the pandemic.

Partly supporting the third hypothesis, individuals who had reduced wages or were involuntarily furloughed from work faced a significantly higher chance of being depressed compared to individuals whose income or employment status was unruffled by COVID-19. More specifically, they were more vulnerable to elevated depressed mood but not diminished positive emotions. Being furloughed could be a burdensome financial stressor that also amplified feelings of uncertainty and helplessness, further exacerbating depression.

Severity

Severity was not directly related to depression or depressed mood after controlling for several covariates. However, the severity of COVID-19 exposure was a moderator for the relationship between some demographic correlates and depression as well as depressed mood. First, female participants living in regions of high severity were most susceptible to depression and depressed mood when compared to male

participants. Hence, in less severely impacted areas, like Shanxi or Sichuan, women and men were more equally affected by the repercussions of COVID-19 than their counterparts living in SeA, where females were at a disadvantage. Second, more years of education was related to decreased depression and depressed mood in mildly impacted areas, but not in severely impacted areas. Education, being a consistent protective factor against the destructive consequences of COVID-19, was more effective when risk remained low and manageable, yet as severity rose, education lost its benefits. The findings highlighted unique challenges that residents in SeA encountered, possibly due to a combination of stressors, including more significant perceived discrimination, stricter lockdown policy, and a higher risk of contracting the virus.

Contrary to the findings of depression and depressed mood, severity was negatively associated with changes in positive emotions. Neither of the six interaction terms yielded significant results. A subsequent simple slope analysis of the marginally significant relationship between education and severity suggested that more years of education was associated with greater positive emotion regardless of severity. However, the effect was stronger in MiA or MoA.

Gender, age, education, marital status, changes in employment status were pertinent factors to consider when studying changes in the psychological well-being of those facing the pandemic. Throughout the investigation, younger age and lower educational attainment were consistent risk factors for depression, whereas, gender, marital status, and being furloughed from work were situation-specific. The pattern of positive emotion was distinct from models of depression and depressed mood, suggesting that positive affect operated through a distinctive pathway to depression. The findings illustrated that outcomes differed depending on symptoms assessed, accentuating the need to identify symptoms of interest and to match them with the most appropriate and applicable scale or measurement approach.

Limitation

Several limitations of the study should be acknowledged. The first limitation concerns the sampling strategy of the comparison norm. Our goals were to compare a sample collected during a normal situation (i.e., 2016) with one collected during a global emergency, and further examine whether there were differences among participants from severely, moderately, and mildly affected areas (i.e., 2020). Given the nature of a convenient sample in 2020, concerns might arise as to if they truly represented residents of each province investigated. Although we did adopt an adequate size of sample and recruited from multiple platforms to avoid sampling and estimation biases, future studies with both pre- and post-pandemic data in the same sample may better control for potential confounds. Second, the self-reported CES-D scale was only suitable for evaluating levels of depression and not anxiety, since they are highly comorbid, particularly

given that 29% of respondents reported moderate to severe anxiety symptoms in another study (24). CES-D was adopted here because the primary interest was to assess depression. Other studies are encouraged to evaluate a wide range of outcomes. Third, actual stressors specific to COVID-19 and the experience of containment were not assessed and precluded to keep the survey brief. It is unclear how unique stressors, such as contact history with confirmed cases, health status, pre-existing mental disorder, lack of socioeconomic resources, and stigma, are related to psychological distress.

CONCLUSION

The study examined a narrow range of psychological consequences of COVID-19 in Chinese residents who were living in MiA, MoA, and SeA, compared to a baseline group living in the same provinces in 2016. The outbreak was related to individuals' increased symptoms of depression, elevated levels of depressed mood, and diminished positive emotions. Stigma and local government policies may stir waves of distrust among neighbors and friends and feelings of marginalization and isolation, especially for residents in the Hubei province. Timely psychological interventions are necessary for individuals in need, particularly those who are single, unemployed due to COVID-19, and have fewer years of education.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Review Board of Tsinghua University, Department of Psychology. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

XH, ZY, KB, and SC designed the study and analyzed the data under the supervision of PS. XH, SC, KB, ZY, and PS discussed the results and wrote the paper together. All authors contributed to the article and approved the submitted version.

FUNDING

This research received funding from the Tsinghua University Spring Breeze Fund (20201080524), the China Narcotics Control Foundation (CNCF-2016-22) and the Natural Science Foundation of China (81671065).

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Insights for Fostering Resilience in Young Adults With Multiple Sclerosis in the Aftermath of the COVID-19 Emergency: An Italian Survey

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OPEN ACCESS

Edited by:

Carlo Lai,
Sapienza University of Rome, Italy

Reviewed by:

Maria Luisa Martino,
University of Naples Federico II, Italy

Federica Graziano,
University of Turin, Italy

Lidia Borghi,
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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 28 July 2020

Accepted: 29 December 2020

Published: 22 February 2021

Citation:

Donisi V, Gajofatto A, Mazzi MA, Gobbin F, Busch IM, Ghellere A and Rimondini M (2021) Insights for Fostering Resilience in Young Adults With Multiple Sclerosis in the Aftermath of the COVID-19 Emergency: An Italian Survey. *Front. Psychiatry* 11:588275. doi: 10.3389/fpsy.2020.588275

Objective: Recent evidence has demonstrated that the COVID-19 pandemic is taking a toll on the mental health of the general population. The psychological consequences might be even more severe for patients with special healthcare needs and psychological vulnerabilities due to chronic diseases, such as multiple sclerosis (MS). Thus, we aimed to explore the psychological impact of this pandemic and of the subsequent healthcare service changes on young adults with MS living in Italy and to examine their coping strategies and preferences regarding psychological support in the aftermath of the pandemic.

Methods: Data were collected using a cross-sectional, web-based survey advertised on social networks. We report both quantitative (descriptive statistics, *t*-tests, and one-way ANOVA) and qualitative data (inductive content analysis).

Results: Two hundred and forty-seven respondents (mean age 32 ± 7 years), mainly with relapsing–remitting MS, from all Italian regions participated. Participants felt more worried, confused, sad, and vulnerable because of the disease “during” the pandemic in comparison to their self-evaluation of the period “before” the COVID-19 outbreak. Similarly, their perception of control over MS decreased “during” the pandemic in comparison to the retrospective evaluation of the period “before” the COVID-19 outbreak ($p < 0.01$). Canceled/postponed visits/exams were listed as the most frequent MS management changes, with modified/postponed pharmacological treatment representing the most stressful change. Psychological support in dealing with pandemic-related fears and improving MS acceptance and well-being was considered extremely important by almost 40% of the respondents. Different coping strategies were mentioned in the qualitative section of the survey, with social support, hobbies, and keeping busy being the most frequent ones.

Conclusions: Considering the enormous impact of the pandemic on young adults with MS, we urge MS clinical centers to implement psychological support programs

that address the potentially long-lasting psychological negative impact, thus fostering the therapeutic alliance that is being threatened by the infection prevention measures imposed during the pandemic, and promoting psychological resources for adaptively managing future waves of COVID-19.

Keywords: pandemic, COVID-19, multiple sclerosis, resilience, psychological adjustment, coping strategies, psychological support

INTRODUCTION

Multiple sclerosis (MS) is the most common chronic neurological disease causing disability in young adults. Relapsing forms are characterized by acute/subacute onset of neurological symptoms followed by complete or partial recovery and subsequent periods of relative well-being, whereas in the progressive forms, the disease shows a worsening of neurological symptoms with an increase in disability independent of relapses (1). In addition to the possible physical limitations due to neurological symptoms, MS patients experience psychological distress and are at higher risk of depression and anxiety compared to the general population (2–4). Since MS is generally diagnosed in a stage of life of great significance for the achievement of personal goals (i.e., between the ages of 20 and 40) (5, 6), the adaptation to this chronic disease, especially in the first years after MS diagnosis, may become even more emotionally challenging (7–12).

It is widely recognized that MS pathogenesis is driven by an immune system dysregulation targeting the central nervous system (13, 14). For this reason, currently available disease-modifying therapies are represented by drugs with immunomodulatory and/or immunosuppressive mechanisms of action, which may significantly ameliorate the disease course (15, 16). While this is clearly reassuring for patients and clinicians, the potential risk of adverse events may be worrisome, particularly in situations of vulnerability. In routine clinical practice of many countries, patients with MS regularly access the outpatient clinic both to check their clinical status and to monitor the effectiveness and safety of ongoing treatment; the frequency of visits depends on patient age and disability, disease characteristics, and therapy. Typically, each MS patient contacts or accesses a specialized clinical center multiple times a year (17).

In December 2019, a respiratory infection (i.e., COVID-19) caused by a novel coronavirus, namely, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was detected in China and rapidly spread worldwide in the following weeks, causing soon a pandemic (18). Italy has been one of the first and most severely affected countries outside China (239,410 infected people with 34,644 deaths as of June 24 2020—Istituto Superiore di Sanità) (19), leading the Italian government to initially declare the state of emergency starting from January 31, 2020, and, subsequently, from the end of February, to implement progressive restrictions of movement culminating in the country lockdown imposed from March 10 to May 3 2020, followed by a gradual lifting of these measures in the months of May and June 2020. The emergency due to the COVID-19 pandemic has significantly impeded the regular access of patients to MS centers. Indeed, among other restrictions, the health security

measures taken by the Italian Government to contain the spread of infection imposed the suspension of non-urgent care (20). To ensure continuity of care and treatment for MS patients, clinicians opted for alternative communication strategies, such as telemedicine tools (e.g., emails, phone calls, and videocalls) (21–23).

Recent studies have highlighted the psychological burden of the COVID-19 pandemic, including high prevalence rates of psychological symptoms and disorders, with potentially long-lasting effects (24–26). As indicated by previous experience during the 2002/2003 severe acute respiratory syndrome coronavirus epidemic, psychological interventions could be a favorable option also for chronic patients to deal with the adverse psychological impact (27). However, to the best of our knowledge and at the moment of preparation of the current paper, studies exploring the psychological impact of the COVID-19 pandemic on patients with MS are still sparse. Those articles do not explore specifically the changes in patients' disease perceptions or expectations on psychological support (28–33). Moreover, none of these articles integrated quantitative and qualitative methods.

To fill this gap, the aims of this explorative study were 4-fold: (i) to describe the potential psychological impact of the COVID-19 pandemic on MS perceptions of young adults with MS, (ii) to examine changes in the management of the disease and the provision of health services and their perceived stress linked to those changes, (iii) to explore their preferences in terms of psychological support, and (iv) to explore their coping strategies in facing the pandemic consequences.

To achieve these aims, qualitative and quantitative methods have been synergically applied. In particular, a quantitative approach has been applied for the first three aims and a qualitative one for the latter. We assumed an increase of negative emotions regarding MS and of the sense of vulnerability and a reduction in control perception over MS due to the pandemic, a high level of perceived stress linked to the changes in the management of MS regarding different aspects of MS care. Further, we supposed that young adults with MS would consider psychological support highly relevant.

METHODS

The study is part of a larger project (ESPRIMO project), a prospective program aiming to study and promote resilience in young adults with MS. This general objective will be pursued through the activation of a working group that will involve, in the different phases of the program, the main stakeholders: health professionals (e.g., neurologists, psychologists, nurses, and

rehabilitators), researchers from multiple disciplines related to basic research and applied research, MS patient associations (e.g., local Italian Multiple Sclerosis Association), patients with MS, territorial bodies (e.g., municipality), and private entities (e.g., foundations). The team is coordinated by a group of clinicians from the Regional Multiple Sclerosis Center of the Borgo Roma Hospital of the Integrated University Hospital of Verona and researchers from the Department of Neuroscience, Biomedicine and Movement of the University of Verona, engaged in care and research activity in the field of MS for many years. The final goal of the project is to develop and evaluate the effectiveness of a biopsychosocial intervention that promotes resilience and adaptation to the disease to increase quality of life in young adults with MS. The project was activated in 2018 as part of the departmental development program “Behavior and well-being: a multidisciplinary approach to promote the quality of life in conditions of vulnerability” of the Department of Neuroscience, Biomedicine and Movement of the University of Verona funded by the Ministry of Education, University and Research. The two core elements of the ESPRIMO project are the BPS-ARMS study and the ESPRIMO feasibility study. The first study aims to explore the resilience and quality of life of young patients by adopting a biopsychosocial approach, that is, by studying the possible clinical, biological, social, and psychological factors connected to adaptation and resilient reaction to disease event in patients at onset. The second study will last 24 months, following three main consequential phases: the initial co-creation phase aiming to develop a biopsychosocial intervention (the so-called ESPRIMO intervention) targeted at young adults with MS; the intervention phase aiming to test preliminary effect, feasibility, and acceptability of the ESPRIMO intervention in a sample of young patients with MS; and the third phase aiming to fine-tune the ESPRIMO intervention.

As part of the project “ESPRIMO,” the present study has been approved by the Ethical Committee of the Verona Hospital (Prog. 2676CESC) and registered on ClinicalTrials (ClinicalTrials.govID: NCT04431323). The study uses a cross-sectional, observational design and followed the STROBE checklist (34).

Data were collected between May 13 and June 3, 2020, using a web-based, anonymous survey. Young adults with MS, being a resident of Italy during the COVID-19 pandemic, and meeting the following inclusion criteria could participate: age 18–45 years, MS diagnosis, Italian speaker, and electronic informed consent signed.

According to the ESPRIMO project, the definition of the age range for “young adults” from 18 to 45 years is made on the basis of the clinical onset of MS and course of the disease. Indeed, it has to be noticed that a clear age cut-off for the definition of “young adult” has not been established in the medical field, and, as discussed in a previous paper in the field of neurology in Italy, an age cut-off might be considered arbitrary (35). In our case, the age range has been defined on the basis of the age range of MS onset (i.e., 20–40 years), extending the age of inclusion, setting the minimum age to 18, and widening the maximum age to 45. MS is a chronic disease and typically long clinical course leading to a relevant group of patients reaching elderly with the

disease. Consistently, Garcia and Finlayson (36) defined people from the age of 45 as “aging with MS”. Therefore, we focused on a subgroup of MS patients who could be considered “young” given the disease history.

The survey was advertised on the Facebook page and the Instagram profile of the ESPRIMO project as well as in several Facebook groups focusing on MS. The advertisement also encouraged people to share the survey link to others who are potentially eligible. Electronic informed consent was obtained from all participants prior to data collection.

Survey

We created an *ad hoc*, self-administered questionnaire composed of closed and open questions, divided into four sections aiming to explore the following topics: psychological impact (section 1 and section 2b), changes in MS management (section 2a), preferences regarding psychological support (section 3), and psychological resources (section 4) (**Appendix 1**). Moreover, some sociodemographic and clinical data have been collected.

The psychological impact of COVID-19 has been quantitatively explored in section 1: self-reported perceptions about the MS regarding emotions, illness perception, and commitment to deal with MS before and during the pandemic. Since the existing brief and validated questionnaires were not able to explore all these specific areas, we created an *ad hoc* scale, composed of seven items evaluating the following MS perceptions on two 10-point Likert scales (i.e., before the COVID-19 emergency and during the COVID-19 emergency): a range of feelings about the MS disease (i.e., anxiety, confusion, sadness), illness perceptions (i.e., vulnerability, control over illness), and commitment to deal with MS (i.e., commitment to manage the disease and to seek social support). The analysis of the Cronbach alpha considering these seven items indicates a high reliability for the two considered time frames (before COVID-19 = 0.81 and during COVID-19 = 0.84).

The second section explored both (a) changes in the services offered by clinical centers (e.g., medical visits, psychological visits, pharmacological treatment, and telemedicine) and (b) psychological impact in terms of perceived stress linked to the changes in MS care. When answering to this question, respondents could pick up more than one change and also add other changes not listed in the questionnaire. Stress was assessed using a 10-point Likert scale, ranging from 1 (“no stress”) to 10 (“maximum level of stress”).

Moreover, a third section explored needs and preferences regarding psychological support of young adults with MS.

Finally, the fourth section qualitatively investigated participants’ psychological resources (namely: coping strategies, helpful/positive thoughts and learnings). In the present study, we will focus on coping strategies, defined by Lazarus and Folkman (37) as “constantly changing cognitive and behavioral efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person”. Coping strategies were investigated by asking the following question: “Please complete the following sentence: The strategy that has proven most useful for getting through this pandemic period has been...”

The survey has been implemented using the software LimeSurvey, an open source online tool that allows to develop, publish, and collect responses to surveys.

Data Analysis

Statistical Analysis

Descriptive statistics were presented as mean values and standard deviation (SD) for continuous variables and as absolute and relative frequencies for categorical variables. A set of Student's paired *t*-tests were applied to compare participants' levels of negative emotions, illness perception, and commitment to deal with MS before and during the pandemic. Student's two-group *t*-tests and one-way ANOVA were used to explore the differences across the main sociodemographic variables (see **Tables 1–5** in **Appendix 2**; gender differences have been explored only on a sub-sample of participants).

A choropleth map, showing the spatial distribution of respondents among the Italian regions, was drawn with the Stata package *grmap*. All the analyses were performed with STATA 15.

Inductive Content Analysis

Participants' answers to the open question on coping strategies were grouped in an Excel file. Two researchers (AGh and VD) independently analyzed all answers and created a list of possible labels. Interrater reliability had good results: the percentage of agreement was 90% (CI 86–94%), Krippendorff's Alpha 0.88 (CI 0.84–0.93). These labels were then compared in a plenary meeting, and concordant and discordant labels were discussed with a third reviewer (MR). As a next step, all answers were coded using the finalized labels. Answers containing more than one type of coping strategy were divided into different utterances and coded separately. Frequencies of different types of coping strategies are reported.

RESULTS

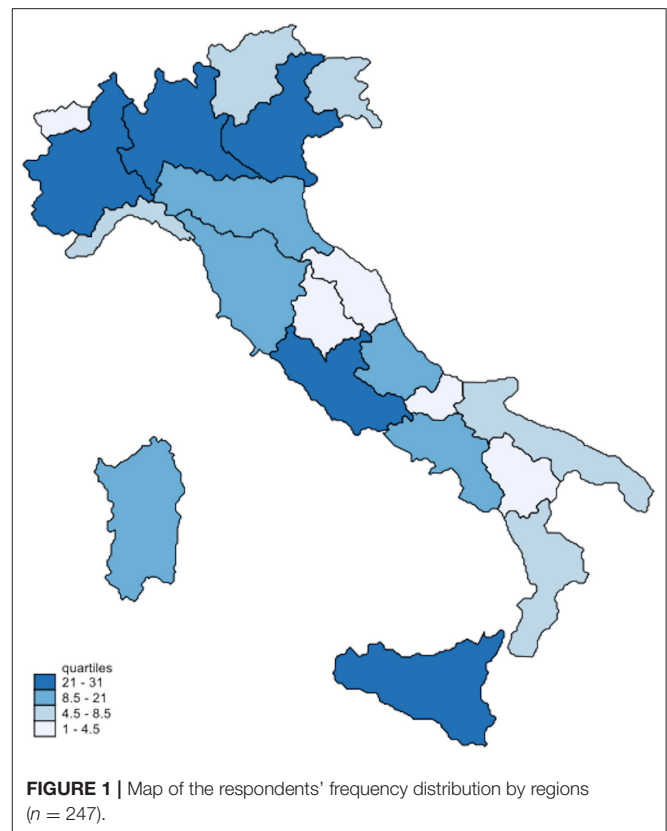
Sociodemographic Characteristics of the Sample

Of the 368 young adults with MS who accessed the survey, 67 were excluded according to the exclusion criteria (i.e., 14 for age, 53 not giving the consent). Furthermore, 52 of the surveys were returned empty or with only sociodemographic information compiled and 2 were compiled by residents abroad during the pandemic and thus excluded from further analysis, leaving a total sample of 247 respondents included in the analysis.

Respondents reported a mean age of 32 years (SD = 7) covering all possible ages (i.e., 18–45 years); 44% of respondents were 18–30 years old. Of all respondents, 46% were married or living with a partner, 55% were occupied, and 44% presented at least an academic degree.

Regarding the place of residence during the COVID-19 pandemic, surveys were completed in all Italian regions, with 117 (47%) respondents living in the north, 47 (19%) in the center, and 83 (34%) in the south of the country (see **Figure 1**).

Most respondents reported a diagnosis of relapsing–remitting MS (227; 92%), whereas 7 (3%) had primary progressive MS, 8



(3%) had secondary progressive MS, and 5 (2%) had clinically isolated syndrome (CIS).

Emotions Regarding MS, Illness Perceptions, and Commitment to Deal With the Disease Before and During the COVID-19 Pandemic

Table 1 summarizes patients' emotions, illness perceptions, and commitment to deal with the disease before and during the pandemic and the impact of COVID-19, calculated as the difference between the values expressed in the two phases ("during" vs. "before"). The mean levels of anxiety/worry and sadness/discouragement linked to MS significantly increased during the pandemic ($p < 0.01$). Similarly, respondents were significantly more confused/disoriented regarding their MS ($p < 0.01$). In addition, we found a negative impact of the pandemic on patients' illness perception, with a significant increase of vulnerability perception and a reduction of personal control over MS ($p < 0.01$). Conversely, patients were equally committed before and during the pandemic to find support and effective strategies to manage the disease.

No significant differences emerged between the two examined age groups (18–30 vs. 31–45 years) for the changes between "during" and "before" COVID-19 in self-reported perceptions about MS. Similarly, these changes did not significantly differ among subgroups regarding the other main sociodemographic

TABLE 1 | Self-reported perceptions about the MS: emotions, illness perception, and commitment to deal with MS before and during the pandemic ($n = 247$).

Items	Before the COVID-19 pandemic (mean, DS)	During the COVID-19 pandemic (mean, DS)	Impact of COVID-19 pandemic (mean, DS)	t-test	Sig.
1: "How anxious/worried do you feel about the course of your disease?"	5.4 (2.1)	6.4 (2.3)	1.1 (2.0)	8.7	< 0.01
2: "How vulnerable do you feel because of your disease?"	5.6 (2.2)	6.9 (2.5)	1.3 (1.9)	10.8	< 0.01
3: "How disoriented/confused do you feel about managing your disease?"	4.6 (2.5)	5.8 (2.8)	1.2 (2.0)	8.9	< 0.01
4: "To what extent do you feel you have control over your disease/you are able to manage your disease?"	6.2 (2.2)	5.7 (2.3)	-0.6 (1.9)	-4.5	< 0.01
5: "How sad/discouraged do you feel regarding your disease?"	5.3 (2.7)	6.1 (2.7)	0.8 (1.8)	7.1	< 0.01
6: "How much energy have you invested in finding support and help in managing your disease?"	5.3 (2.8)	5.3 (2.9)	-0.0 (1.8)	-0.0	0.97
7: "How much energy have you invested in finding effective strategies to manage your disease?"	6.2 (2.6)	6.1 (2.6)	-0.04 (1.8)	-0.4	0.69

characteristics or place of living (north/central/south regions of Italy). See **Tables 1–5** in **Appendix 2** for a detailed description of the results for each item.

Changes in Care Management and Related Perceived Stress

Half of the respondents ($n = 123$) reported changes in MS management during the COVID-19 pandemic. **Table 2** summarizes results regarding the main changes in the healthcare process, including medical, psychological, and physical treatment, as well as pharmacological therapies and re-organization of services (e.g., telemedicine). Mean levels of stress attributed to each specific MS management change are reported as well. Canceled or postponed medical visits or exams were listed as the most frequent changes, whereas changes in pharmacological treatment represented the most stressful change. The general mean score of stress related to the changes described above was 6.5 ($SD = 3$; 3rd quartile = 8).

Needs/Preferences Regarding Psychological Support

Participants rated the importance of psychological support for young adults with MS in the aftermath of the emergency on a scale of 1 to 10 with a mean value of 8 ($SD = 2$; 3rd quartile = 10).

As shown in **Figure 2**, among the respondents ($n = 221$), the majority reported that the psychological intervention should focus on the reduction of unpleasant emotions and on the promotion of strategies to improve MS acceptance, to manage the fear of being infected and the work/socio-relational changes due to the pandemic.

Coping Strategies

Two hundred and eleven MS patients (85%) responded to the qualitative section of the survey, with six being excluded as they answered "no strategy." Two hundred and five patients (83%) described coping strategies in dealing with pandemic-linked stress and were included in the following qualitative analysis.

TABLE 2 | Changes in medical treatment due to the COVID-19 pandemic and the related perceived stress ($n = 123$).

Items	N	Perceived stress (Mean stress value)
Modified or postponed pharmacological treatment	27	7.9
Canceled or postponed physical treatment (e.g., physiotherapy, rehabilitation)	9	7.2
Canceled or postponed medical visits or exams	78	6.6
Telehealth services	31	5.9
Canceled or postponed psychological treatment	19	5.7

*Participants might select more than one change in medical treatment.

Twelve different types of coping strategies were indicated by respondents as useful to deal with the stress, with *social support*, *hobbies*, and *keeping oneself busy* being the most applied ones (see **Table 3**). It has to be noted that 52 respondents reported more than one coping strategy.

Table 6 in the **Appendix 2** reported percentages of participants without a worsening of MS perceptions (i.e., emotions and illness perceptions) for each coping strategy. Social support, hobbies, and keeping oneself busy, which are the three strategies most frequently mentioned as effective by participants, seem to be associated to lower percentages of worsening in terms of sadness and disorientation.

DISCUSSION

This cross-sectional study has been conducted in the aftermath of the first wave of COVID-19 emergency in Italy. Findings allowed us to make a picture of an understudied population, such as the one of young adults with MS, regarding the psychological impact of the pandemic in terms of MS perceptions, changes in MS

management, and consequent related perceived stress. Moreover, the main coping strategies evaluated to be useful by young adults with MS in dealing with the emergency and their perspective on the relevance of psychological support have been explored.

As regards the first aim of the current study, a higher level of anxiety, sadness, and confusion about MS emerged during the pandemic. Although the focus of the survey was on emotions regarding MS, results seem to confirm the negative impact of the pandemic on individuals' mental health, as already suggested by recent studies in the general population (24–26). As regards young adults, Liu et al. confirmed symptoms of depression, anxiety, post-traumatic stress disorder, loneliness, and poor resilience in adults under 30 years (39). Looking at the whole Italian context, among the general population, the young adult subgroup seems to be particularly vulnerable to the COVID-19 pandemic, as reported by Forte et al. who showed a greater negative psychological impact on people under 50 years (25).

However, considering the recent publications focusing on the psychological impact of COVID-19 pandemic in the MS population, results appear to be more controversial. Indeed, a study on patients with MS in a southern region of Italy indicated no increase in anxiety and depression and also some improvements on quality of life during the first wave of the pandemic (33), whereas other authors showed a high level of anxiety (29, 32). However, it has to be noted that, even if containment and control measures equally applied to all Italian regions during the period of the current study, the risk of contracting COVID-19 varied across Italy, and, as recognized by the Capuano et al., their contrasting results might be explained also by the fact that during the first wave, the southern regions of Italy were much less affected by the COVID-19 epidemic (33).

However, to consider the national differences in pandemic spread, which may have led to varying degrees of perceived risk and uncertainty among respondents, depending on area of residence, and, additionally, the potential differences in organization and delivery of MS health services, which might be different across the various MS centers, a comparison of changes in MS perceptions among survey participants living in the northern, center, or southern regions has been conducted, resulting in no differences. Similar to our results, the recent study of Forte et al. (25) assessing different measures of psychological impact found significant differences between the north, center, and south of Italy only for sleep disturbances.

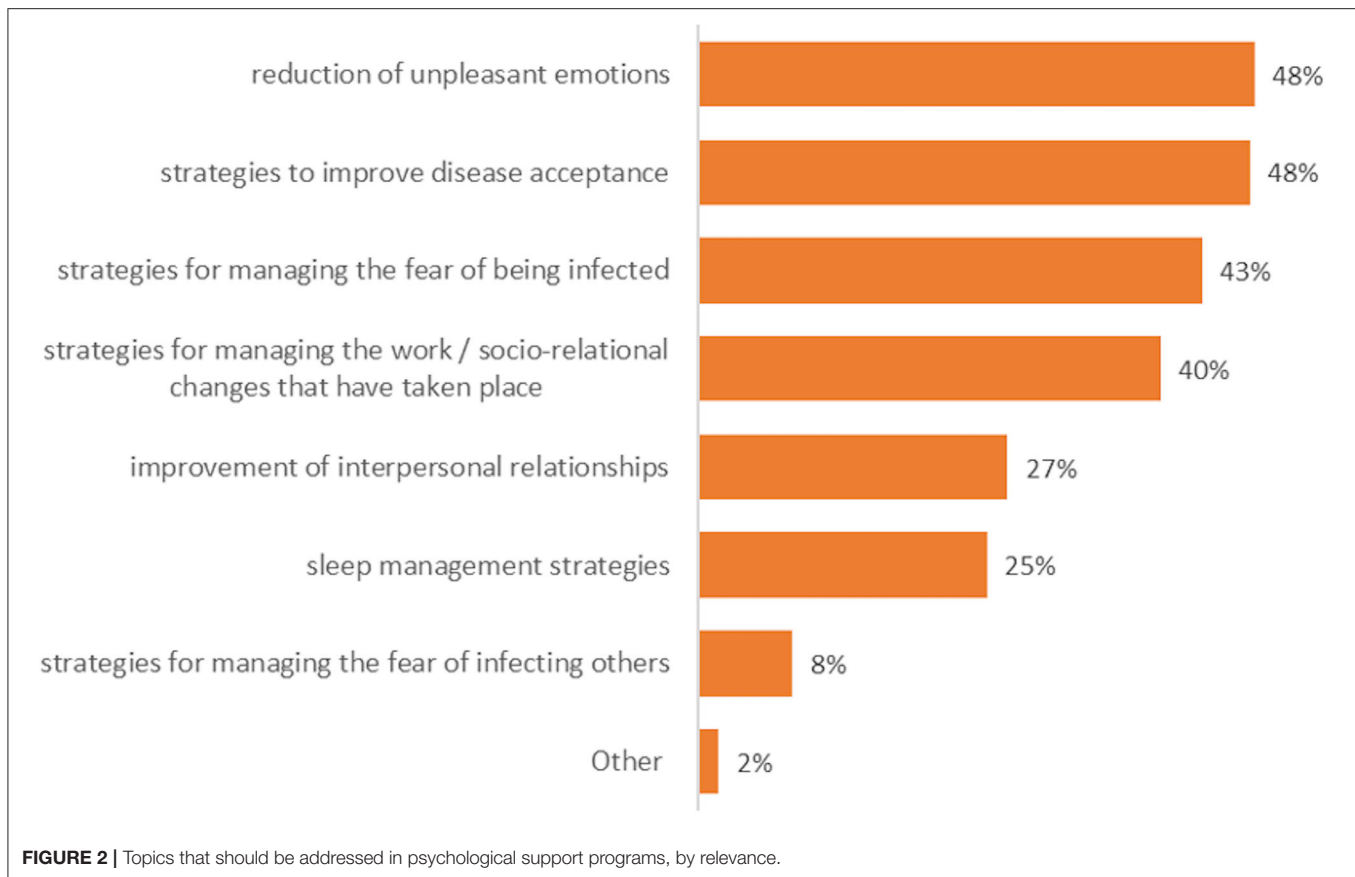
Moreover, a similar worsening in emotions and illness perceptions linked to MS emerged when considering both young adults under 30 years or the ones in the 31–45 age range and other sociodemographic characteristics.

The increase of anxiety, sadness, and confusion is consistent with the theme of uncertainty, which might be considered a common feeling that characterized the experience of people during the pandemic, due to the novelty of the emergency, severe symptoms, high mortality rates, lack of cure, the severe consequences for daily life and society, and the highly unpredictable future course of the pandemic (25, 40). Uncertainty is a familiar psychological construct for people who have to live with chronic illness. Indeed, due to the complexity and unpredictability of clinical course and potential treatment

side effects, people with MS have to accept in their adaptation to illness and chronicity that not all the aspects of their health can be controlled and foreseen (41–43). In line with this evidence, our results suggest that the public health emergency has negatively influenced MS perceptions for young adults with MS, leading to an increased sense of vulnerability and lack of control over MS.

As regards our second aim, half of the respondents highlighted at least one change in the MS management due to the COVID-19 pandemic. Although respondents indicated an overall moderate level of perceived stress, 44% considered these changes as severe (i.e., 8–10 on the 10-point Likert scale). The high relevance of MS management changes is consistent with a previous research, highlighting the fact that patients with MS in Saudi Arabia reported a significant impact of the pandemic on their MS healthcare, in particular due to fear of being infected (44). Although canceled or postponed medical visits or exams have been, according to the participants' perspective, the most frequent change in MS management, the modified or postponed pharmacological treatment had the worst impact on perceived stress. Though we did not explore this relationship in our analysis, we might hypothesize that changes in routine clinical procedures, a reduced number of encounters with healthcare professionals, and the postponement of care and the associated perceived stress might have also contributed to uncertainty and thus the reduced level of perceived illness control and increased vulnerability perception. To support this consideration, a recent Serbian study reported the impossibility to go to hospital as usual, the difficulties in drug availability, and the worsening of the MS status in case of contagion as the main concerns regarding relapsing–remitting MS during the pandemic outbreak. During the pandemic, the use of telemedicine and digital services has been widely extended to compensate for the reduction of services provided in person. As previously suggested, telemedicine should be offered in order to effectively respond to the needs of MS patients in times of emergency, such as the COVID-19 pandemic (21, 23, 45). Moreover, considering the high use of web and mobile applications by young adults, e-health resources, aiming to provide strategies and support in dealing with stress and emotions linked to the pandemic, might be especially useful. Indeed, as regards our third aim, almost 40% of the respondents rated as extremely important (i.e., 10 on Likert scale) the opportunity to receive psychological support, stressing not only the support in dealing with emotions and MS acceptance in general but also in managing the fear of being infected.

Looking at the last explorative aim, our respondents seemed to adopt a wide range of coping strategies to deal with the stress linked to the COVID-19 emergency. Overall, looking to the variety of coping strategies, the most frequent strategies evaluated as useful in patients' eyes were social support, hobbies, and keeping oneself busy. Results are quite different from what was observed in a previous study where active coping and religion were the strategies most frequently adopted in order to face COVID-19 (31). Conversely, the relevance of those coping strategies, which emerged in our study, was consistent with other results reported during the COVID-19 pandemic and, more in general, in the chronic disease field, as discussed in the section below.



The evaluation of social support as one of the main coping strategy in dealing with the pandemic is coherent with the consideration that, in general, perceived social support and positive relationships are associated with better MS adjustment (41). Consistently, in the other Italian study mentioned above, authors highlighted that patients during the pandemic might have experienced a higher social support (e.g., more opportunity to spend time with family members) that could have been associated to the absence of worsening in depressive symptoms (33). Similarly, a recent survey assessing US young adults during the COVID-19 pandemic reported that family support is associated with low levels of psychological symptoms (39). The category “social support” contained not only respondents’ quotes regarding the support received by others but also the support they provided to relevant people during the pandemic, thus suggesting that in challenging or even threatening situations, connection and empathy among relatives and friends might play a significant role in protecting from perceived stress.

Interestingly, among the most frequently useful coping strategies, we also found pleasant and meaningful activities in everyday life that mostly rely on personal internal resources (i.e., hobbies), suggesting the beneficial power of engaging in value-consistent actions that stimulate creativity (e.g., cooking, painting) and personal growth (e.g., reading). Similarly, physical activities and meditation/relaxation also emerged as relevant strategies for respondents’ personal well-being.

“Keeping oneself busy” was also frequently considered as effective by young adults with MS. A similar result emerged in Umucu and Lee (46), who highlighted self-distraction with other activities as one of the most frequent coping strategies with COVID-19 among participants with chronic conditions and disability. As reported in a previous study in the context of chronicity, this strategy might have a controversial role in terms of adaptiveness (47). In general, we might assume that if it is applied to deny stress and avoid any stressors, it can be maladaptive for emotion regulation. In contrast, if it is used to mitigate uncertainty and fear linked to COVID-19 in the short period, it might help to preserve a sense of self-efficacy and control in daily life.

Similar to the study by Umucu et al. who reported the “tendency to deny the reality of COVID-19” as the least commonly used strategy, in our sample, “experimental avoidance” also emerged only in a small number of quotes (46).

Although the survey was not aimed to make a diagnosis of psychiatric disorders or identify patients with high risk of scarce adaptation to MS, the detected significant negative psychological impact indicates that this aspect has to become one of the priorities of clinical centers when restarting routine healthcare after the emergency phase and during the further wave(s) of the pandemic. Indeed, unfortunately in Italy, at the moment in which this paper is under revision, a second wave of the pandemic is occurring with healthcare services being newly affected by

TABLE 3 | Applied coping strategies during the time of the pandemic, including examples and frequencies ($n = 205$).

Type of coping strategy	Description	Example	Number of quotes
Social support	Turning to friends, the partner, family members, children, or psychosocial support*, using also different types of telecommunication	• "Cultivating relationships, primarily with my partner, but also with friends and family (via video calls and messages)" • "Talking about my fears"	44
Hobbies	Finding new hobbies and/or revisiting old ones, including, for example, reading, gardening, painting, English course, cooking	• "Starting with new hobbies" • "Devoting myself to the things that I like but that before I had no time and way to do"	42
Keeping oneself busy	Efforts to stay active and be occupied, in particular with mental activity and work/studying	• "Focusing on work" • "Doing and learning new things at home that allowed me at that time not to think about multiple sclerosis and various difficulties"	39
Positive thinking	Efforts to think positively, including also positive reappraisal (i.e., attempts to re-construe stressful events as valuable or useful)	• "Taking advantage of uncomfortable situations to create something good" • "Re-evaluating loneliness as an opportunity to feel good with yourself"	29
Following rules/recommendations to prevent the transmission of COVID-19	Behaviors that follow the prevention and containment measures taken by the government and/or the recommendations given by healthcare organizations	• "Limiting personal movement and contact with others as much as possible" • "Taking the necessary precautions without panicking"	24
Physical activity	Efforts to be physically active, either at home or outside	• "Doing physical activity at home or even better outdoors in the garden to enjoy also the sunlight" • "Keeping active, doing exercises"	22
Meditation/relaxation	Efforts to relax one's stressed mind, applying also specific relaxation techniques, such as meditation and breathing	• "Having done mindfulness exercises was very useful" • "Thinking of these days as an opportunity to relax"	19
Patience/acceptance	Efforts to accept or tolerate one's circumstances without becoming annoyed or upset	• "Take the situation with a profound sense of calm" • "Taking life day by day"	18
Experiential avoidance	"Attempts to avoid thoughts, feelings, memories, physical sensations, and other internal experiences even when doing so creates harm in the long-run," (38) including experiences linked to the pandemic	• "Avoiding to think about risk" • "Thinking as little as possible about reality" • "Avoiding thinking"	15
Choosing sources of information carefully	Efforts to stay informed while being selective about news sources	• "Informing oneself by reading reliable sources" • "Contacting the AISM (i.e., Italian Association of Multiple Sclerosis) to receive adequate information"	9
Preserving routines	Endeavors to maintain one's pre-pandemic daily routine	• "Keeping a routine with daily goals" • "Maintaining the pre-COVID routine"	8
Setting/changing priorities	Endeavors to set new objectives and priorities and reassess one's set of priorities acquired prior to the pandemic	• "Rearranging time and priorities" • "Considering it as opportunity to have time to restructure priorities and reorganize the day, doing what I really like to do"	6

*This category includes two quotes regarding psychosocial support received by psychological services.

reduced visits and changes in MS management. Considering changes in MS perception and reducing stress linked to changes in MS management is a priority for healthcare professionals working in MS field, not only because it is strictly linked to patients' global well-being but also because it has implications for patient empowerment in illness management. Indeed, emotional dimensions interact with risk appraisal, rational thinking, and decision-making, key elements that influence health decisions and proactive behaviors in chronic illness (48). Considering the increased level of vulnerability perception and reduced control over the disease, and the continuous uncertainty linked to the further actual spread of the pandemic, psychological interventions, also through telemedicine, should reinforce the therapeutic alliance and continuity of care through empathic and supportive listening. Specifically, as part of a larger project ESPRIMO, results derived from this explorative survey will

contribute to inform the development of the specific ESPRIMO biopsychosocial intervention aiming to promote resilience and health-related quality of life in young adults with MS and, more broadly, enhance patients' adaptation to MS. Indeed, the ESPRIMO intervention should not avoid to also address the potentially long-lasting negative psychological impact and MS management changes caused by the COVID-19 pandemic on this particularly vulnerable clinical population. This also considers that the target population is in the age range of onset of the disease, a period especially difficult for the psychosocial adjustment to the disease (9). On the basis of the current results, the psychological component of the intervention should also foster strategies to better deal with the fear of being at risk of being contagious for COVID-19 and to reduce the sense of vulnerability and the stress linked to the uncertainty and to changes in MS management

and everyday life. The group modalities will characterize the intervention and should favor a shared expression of the COVID-19 experience to foster a sense of acceptance, belonging, and security and potential releases of psychological impact of the pandemic together with the interpersonal learning on useful coping strategies.

Strengths and Limitations

Over the past months, several studies have provided important information on the psychological impact of the COVID-19 pandemic on the general population, healthcare professionals, and some clinical populations, and, more recently, some articles have also explored its impact on MS populations. However, our study presents some novelty aspects that make it unique: exploring the negative effects of the current pandemic specifically for young adults with MS; focusing on the emotions, perceptions, and commitment specifically linked to MS; and using both quantitative and qualitative methods.

Recruiting adults with MS within the ages of 18 to 45 allowed us to explore a group that is particularly vulnerable in terms of adjustment to live with the disease, which is often diagnosed in this age range.

The open qualitative exploration of patients' perspective on self-perceived functional coping enabled us to capture a wide, genuine, and heterogeneous description of all the coping strategies applied during the pandemic by patients, in order to face the risk of infection and their disease. This is in line with our adoption of a resource-based approach oriented to raising and valuing patients' awareness of personal strategies. As previously highlighted, this qualitative approach allowed us to explore an aspect still little investigated, especially in the period when we performed the survey, which was during the first wave of the pandemic when the first priority was to detect emerging psychological needs in the population subject of our clinical interest not making a priori assumption on their coping style. By giving to participants the possibility of reporting their own strategies, we recognize the patients' role as experts; patients feel reassured and motivated in this way and therefore free to report about their own experience, without the fear of saying "something wrong" (49). Future psycho-educational or supporting interventions, based on suggestions provided by peers on the basis of their own real experiences during the first wave of COVID-19, might represent a particularly valuable resource for patients facing further waves of the pandemic.

Furthermore, using online modality for our survey was appropriate considering the explorative nature of the study but presents both limitations and strengths. As regards limitations, the fulfillment of inclusion criteria was self-evaluated by participants, thus limiting the control on the sampling and potentially the accuracy of the answers. As regards strengths, using online modality guaranteed safety in the aftermath of the COVID-19 pandemic; had the ability to reach a larger pool of potential participants within a shorter period of time, reducing costs and improving efficiency of data collection and management; allowed the recruitment of patients from

the whole of Italy, including patients otherwise difficult to approach; and provided improved comfort and sense of control for participants (50, 51). Moreover, it has to be considered that social media represented an especially powerful tool to recruit our specific sample, since it is known to be a very popular channel of interaction for young adults (52). As regards the second aspect, it has to be considered that by advertising the survey among online MS groups, we reached mainly patients already involved in MS management and probably missed more isolated patients, who might represent also the most vulnerable group. Moreover, in terms of generalizability, considering that almost all the respondents reported a diagnosis of relapsing–remitting MS, our study did not sufficiently capture the psychological impact and needs of patients with different types of MS during COVID-19 emergency. Moreover, given that participation was voluntary, it might be assumed that patients more interested in psychological topics were more likely to participate, thus leading to a potential selection bias.

A strength lies in the comparison of patients' emotions regarding MS, illness perception, and commitment to deal with MS before and during the pandemic. Although a specific time frame is difficult to define and might vary subjectively since the spread of COVID-19 varied across Italian regions, the survey has been conducted in the aftermath of the first wave of the pandemic, and in answering, patients refer to a period characterized by major quarantine policies in place (e.g., severe restrictions of movement, reduced outpatients visits in most of the public and private hospitals, complete or partial shutdowns of economic and social activities) and a widespread perception of high risk due to the large numbers of reported cases and deaths. Although this methodology has been previously used in another Italian paper on COVID-19 (25), it must be noted that participants' retrospective self-reports might be influenced by recall bias, thus potentially influencing the perception of the participants and the validity of our findings. Therefore, the lack of a proper longitudinal design for evaluating the psychological impact represents one of the main limitations of the study. Moreover, we preferred to create an *ad hoc* scale for this specific aim of the study, which showed high reliability. However, the scale was not validated.

The fact that our sample covered all the Italian regions represents an additional strength, as previously reported being able to collect data from areas with different degrees of transmission. Indeed, the only previous study that considered the psychological impact of the pandemic on patients with MS in Italy was based on a relatively small sample size of patients living in a specific region in the south of Italy. However, regarding the sociodemographic and clinical information explored in the survey, some weakness has to be highlighted too; in particular, the exploration of gender was limited to just a low percentage of our participants. Moreover, we did not assess and consider if participants or their family members were actually exposed to the virus and got infected. Therefore, future studies are needed in order to deepen the role played by sociodemographic and clinical characteristics on the psychological impact of COVID-19 within chronicity.

CONCLUSIONS

Tackling the psychological impact of COVID-19 international emergency and of the consequent changes in healthcare organizations aimed to reduce the risk of disease transmission should be a top priority for MS clinical centers that are striving for continuous improvement. Psychological support programs tailored to patients' individual psychological needs and preferences would help to strengthen the therapeutic alliance that has been threatened by the infection prevention measures imposed during the pandemic and to foster patients' capacity for adaptation and "bouncing back" in the face of significant sources of stress [i.e., resilience (53)] such as the COVID-19 experience.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are available from the corresponding author on reasonable request.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by CESC: Ethical Committee of the Verona Hospital. The patients/participants provided their informed consent to participate in this study.

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AUTHOR CONTRIBUTIONS

MR and VD conceived the study and the study design and drafted the manuscript. MM performed the statistical analysis. MR, VD, and AGh performed the qualitative analysis. IB, FG, AGh, and AGa contributed with data collection and relevant contents to the drafted manuscript. All authors reviewed and revised the manuscript.

ACKNOWLEDGMENTS

The authors are very thankful to all the survey participants and all individuals and associations that promoted the survey. The authors thank for the support and collaboration all members of the ESPRIMO project and of the program MIUR-Dipartimenti Eccellenti: Behavior and well-being: a multidisciplinary approach to promote the quality of life in conditions of vulnerability of the Department of Neuroscience, Biomedicine and Movement Science of the University of Verona.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2020.588275/full#supplementary-material>

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Conflict of Interest: AGa reports personal fees and non-financial support from Biogen, Merck, grants from Cesare Serono Foundation, Eurimmun, and Cariverona Foundation, outside the submitted work.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Psychological State Among the General Chinese Population Before and During the COVID-19 Epidemic: A Network Analysis

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OPEN ACCESS

Edited by:

Carlo Lai,
Sapienza University of Rome, Italy

Reviewed by:

Yonggang Su,
Shandong University, China
Goran Zoran Stanojević,
University of Niš, Serbia

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 05 August 2020

Accepted: 13 January 2021

Published: 26 February 2021

Citation:

Ge F, Zheng A, Wan M, Luo G and
Zhang J (2021) Psychological State
Among the General Chinese
Population Before and During the
COVID-19 Epidemic: A Network
Analysis. *Front. Psychiatry* 12:591656.
doi: 10.3389/fpsy.2021.591656

Background: The infectious disease Coronavirus Disease 2019 (COVID-19) outbreak in 2019 spread to multiple countries. The quick spread of the virus and isolation strategies may trigger psychological problems. Our aim was to explore the dynamic network structure of the psychological state before and during the epidemic.

Methods: A web-based survey was conducted in two stages: the T1 stage (1 January 2019 to 31 December 2019) and the T2 stage (1 February 2020 to 8 March 2020). In both stages, the Patient Health Questionnaire-9, General Anxiety Disorder-7, and Pittsburgh Sleep Quality Index were used to assess depression, anxiety, and sleep, respectively.

Results: We matched the data based on IP addresses. We included 1,978, 1,547, and 2,061 individuals who completed the depression, anxiety, and sleep assessments, respectively, at both stages. During epidemics, psychomotor agitation/retardation, inability to relax, restless behavior, and the frequency of using medicine had high centrality. Meanwhile, the network structure of psychological symptoms becomes stronger than before the epidemic.

Conclusion: Symptoms of psychomotor agitation/retardation, inability to relax, and restless behavior should be treated preferentially. It is necessary to provide mental health services, including timely and effective early psychological intervention. In addition, we should also pay attention to the way patients use medicines to promote sleep quality.

Keywords: COVID-19, psychological state, network analysis, longitudinal study, general population

INTRODUCTION

In December 2019, an outbreak of the Coronavirus Disease 2019 (COVID-19) suddenly outbreak (1). The World Health Organization (WHO) defined COVID-19 as a pandemic on 30 January 2020 (2). As the COVID-19 pandemic influences numerous facets of our society, it also impacts each person in different ways. The general population is already feeling disruptions to daily life. Students must stay at home and are not allowed to attend school. Factories and companies have closed, and the comforting social gatherings that usually fill weekends are off limits. We are feeling uncertain about what could happen in the coming weeks, as we hope to slow the spread of the COVID-19.

Infectious diseases [e.g., severe acute respiratory syndrome (SARS) and COVID-19] and the related containment measures have negative influence on individuals physically and mentally. During the SARS epidemic, higher stress levels, poor sleep, and depressed mood were reported among confirmed cases (3). Fiorillo and Gorwood's (4) and Brooks et al.'s (5) studies found that the quarantine, social distancing, and self-isolation would reduce the social interactions and increase in loneliness (4, 5). Huang et al.'s (6) study found that the incidence of anxiety in medical staff was 23.04% and that there were higher levels of posttraumatic stress symptoms during the COVID-19 epidemic. Ge et al.'s (7) study found that the prevalence rate of probable anxiety and probable insomnia was 12.49 and 16.87% among undergraduate students, respectively. In addition to special groups (confirmed cases, medical staff, and students), COVID-19 has triggered a variety of psychological problems (e.g., anxiety and depression) among the general public (8). Moccia et al.'s (9) research indicated 19.4 and 18.6% of the Italian general population in their survey shown mild and moderate-to-severe likelihood of psychological distress.

Mental health has an irreplaceable role in managing infectious diseases like COVID-2019. Unreasonable emotional reactions may exacerbate disease spread in pandemic areas (10). Thus, it is necessary to pay attention to mental health (e.g., depression, anxiety, and sleep problems) among the general population and provide suitable psychosocial support and prevention strategies.

Borsboom and Cramer (11) and Borsboom (12) have proposed a network theory. Based on this novel perspective, symptoms are consistent with mental disorders. Network structure consists of two elements: nodes and edges. Every node represents a symptom, and each edge demonstrates a relationship between two symptoms. Nodes have different importances in the network. High centrality nodes have stronger connections to many other nodes and have greater effects on the network structure. In addition, high centrality symptoms play a key role in the development, persistence, remission, and relapse of mental disorders (13). Centrality is commonly evaluated with four indices: expected influence, strength, closeness, and betweenness. Nodes do not appear in isolation, and symptoms tend to co-occur if they have a positive edge (14). An event external (COVID-19) to the general population may activate one or more nodes (e.g., fear, insomnia) that in turn activate another based on the strength of the edge linking them (15).

We identified three limits in previous studies on psychological state after sudden public health events. First, most of the studies are cross-sectional studies and only focus on mental health status during or after public health events. A significant drawback of these studies is the ignorance of the intrinsic levels of depression, anxiety, or sleep symptoms. Second, no studies have explored the network structure of psychological state structure during or after public health events. Previous studies only found that the incidence rate of anxiety and/or depression increased among the general population but did not evaluate the relationship between these symptoms. Network analysis provides a new perspective on understanding the connection between symptoms. Third, relatively few studies have focused on the psychological responses of infectious diseases (SARS and COVID-19) among the general

Chinese population (8, 16, 17). Liu et al.'s (18) study found that 23 surveys concern medical staff, 18 surveys concern students, and 9 surveys concern the general population.

We present the first study to use a network model to explore the dynamics of depression, anxiety, and sleep symptoms before and during the COVID-19. Our goal is to explore whether centrality symptoms and global connectivity have changed and provide a general population with more targeted psychological intervention and support.

MATERIALS AND METHODS

Study Sample

Participants were recruited from the WeChat of China online social media platform. The mental health survey was placed on WeChat and targeted all Chinese users aged 18 years or older. The survey was implemented online using a Haola applet, with data stored on a secure server at Sichuan University. The study attained approval from the West China Hospital, Sichuan University. The target population of WeChat users aged ≥ 18 years was 1 billion, representing $\sim 76.9\%$ of the total Chinese population aged ≥ 18 years. Data collection was divided into two stages: the T1 stage (1 January to 31 December 2019) and the T2 stage (1 February to 8 March 2020). The IP addresses contain accurate location information. With the IP address matched, T1 and T2 groups have the same location distribution.

Measures

Patient Health Questionnaire-9

The Patient Health Questionnaire-9 (PHQ-9) is a self-report questionnaire that efficiently evaluates depression based on DSM-IV criteria. It includes only 9 items and takes < 3 min to complete (19). A study has shown that the PHQ-9 has good reliability and validity in Chinese (20). In this study, the Cronbach's alpha value was 0.644 at T1 and 0.674 at T2.

General Anxiety Disorder

The General Anxiety Disorder (GAD-7) is a valid and efficient instrument screening for anxiety symptoms and assessing its severity in both clinical practice and research. Higher scores indicate more severe anxiety symptoms. Evidence also supports its good reliability, criterion, construct, factorial, and procedural validity among Chinese people (21). In this study, the Cronbach's alpha value was 0.686 at T1 and 0.713 at T2.

Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index (PSQI) is a self-rated questionnaire that evaluates sleep quality and disturbances. It only takes 2–5 min to complete. Studies have found the PSQI to be reliable and valid in the assessment of self-reported sleep problems among Chinese people (22). In this study, the Cronbach's alpha value was 0.691 at T1 and 0.771 at T2.

Data Analysis

Missing Data

When using the Haola applet to fill out questionnaires, you can submit the questionnaires only after completing the information completely. Thus, there are no data missing in the research.

Network Estimate

We used R-software (qgraph packages) to estimate the network. The symptoms of depression, anxiety, and sleeping problems were described as nodes, and the correlations between symptoms were described as edges in the network. According to the guidelines of Epskamp and Fried (23), the gLASSO program (conservatively identifying the relevant edges only and discovering the underlying network structure accurately) was used to calculate the network. The estimated value of every edge can be understood as a partial correlation, which represents a unique relationship between two symptoms that were independent of all other symptoms (11). Not all the edges are showing in the network graph. We use the threshold presented by Cao et al. (24) to omit edges, which lead to a low false-positive rate and sparser network graph. In addition, we used Extended Bayesian Information criterion (EBIC) for parameter tuning and then chose the best network estimation. In the present analysis, all variables are detected as ordinal, so polychoric correlations can be calculated automatically by using the `cor_auto` function. Visualization of the network is accomplished by the Fruchterman-Reingold algorithm.

Centrality Estimation

We calculated four node centralities that included closeness, betweenness, strength, and expected influence. We considered that node betweenness and node closeness are often not reliably estimated (25). Node strength cannot reflect the negative relationships between symptoms (13). Thus, we only reported the expected influence in this article, and other node centralities are provided in the **Supplementary Material**.

Network Stability

We evaluated the stability of the network from two aspects: edge weight stability and node centrality stability. We estimated the edge weight stability by bootstrapping the 95% confidence intervals (CI). The fewer overlaps in the CIs show higher stability. We measured the node centrality stability by the correlation stability coefficient (CS coefficient). According to Epskamp's study, to better gain a stable and interpretable centrality, the CS coefficient should be >0.25 and 0.5 (26).

Network Comparison

Global connectivity was conducted using the Network Comparison Test (NCT). NCT is a common estimation method for all kinds of data and networks (27). Global strength, which is defined as the weighted absolute sum of all edges of the network, summarizes the overall connectivity.

TABLE 1 | The basic characteristics.

	Depression	Anxiety	Sleep
Gender (male/female)	1,456/522	1,091/456	1,389/672
Age	32.50 $\pm$ 10.64	29.56 $\pm$ 9.58	27.21 $\pm$ 7.16

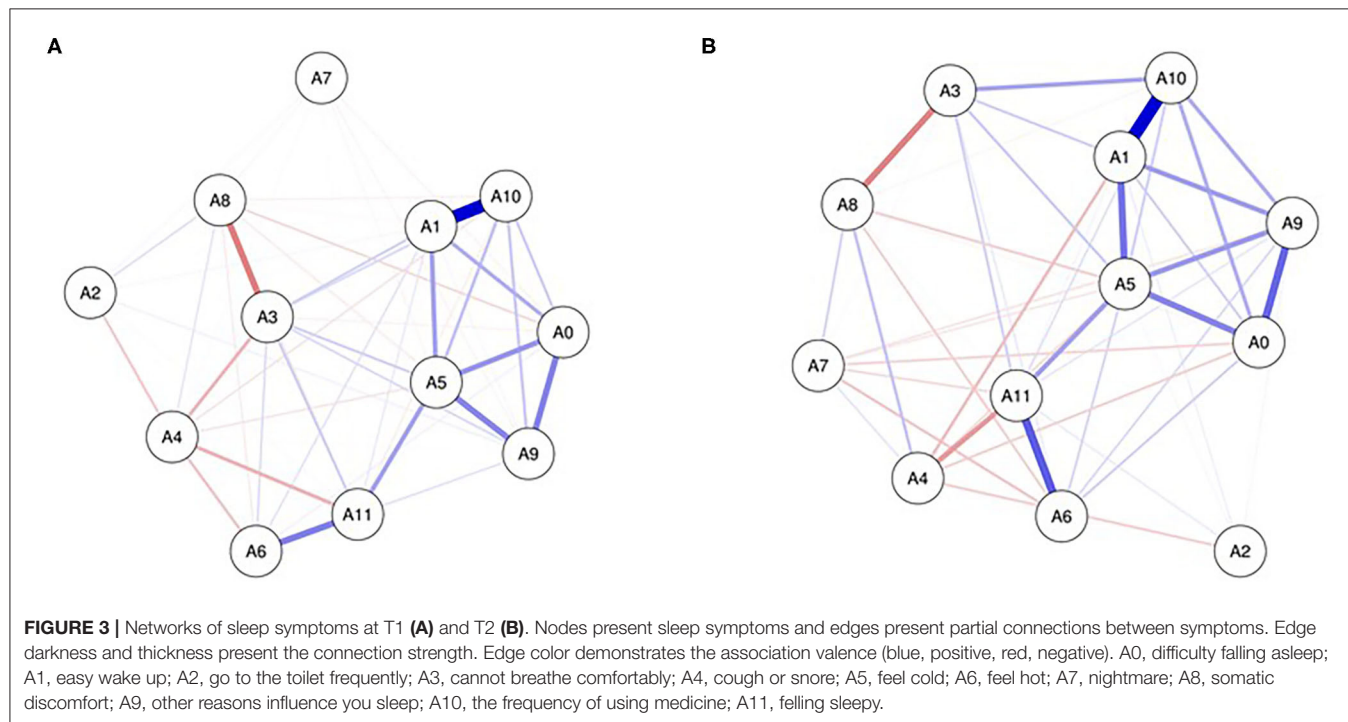
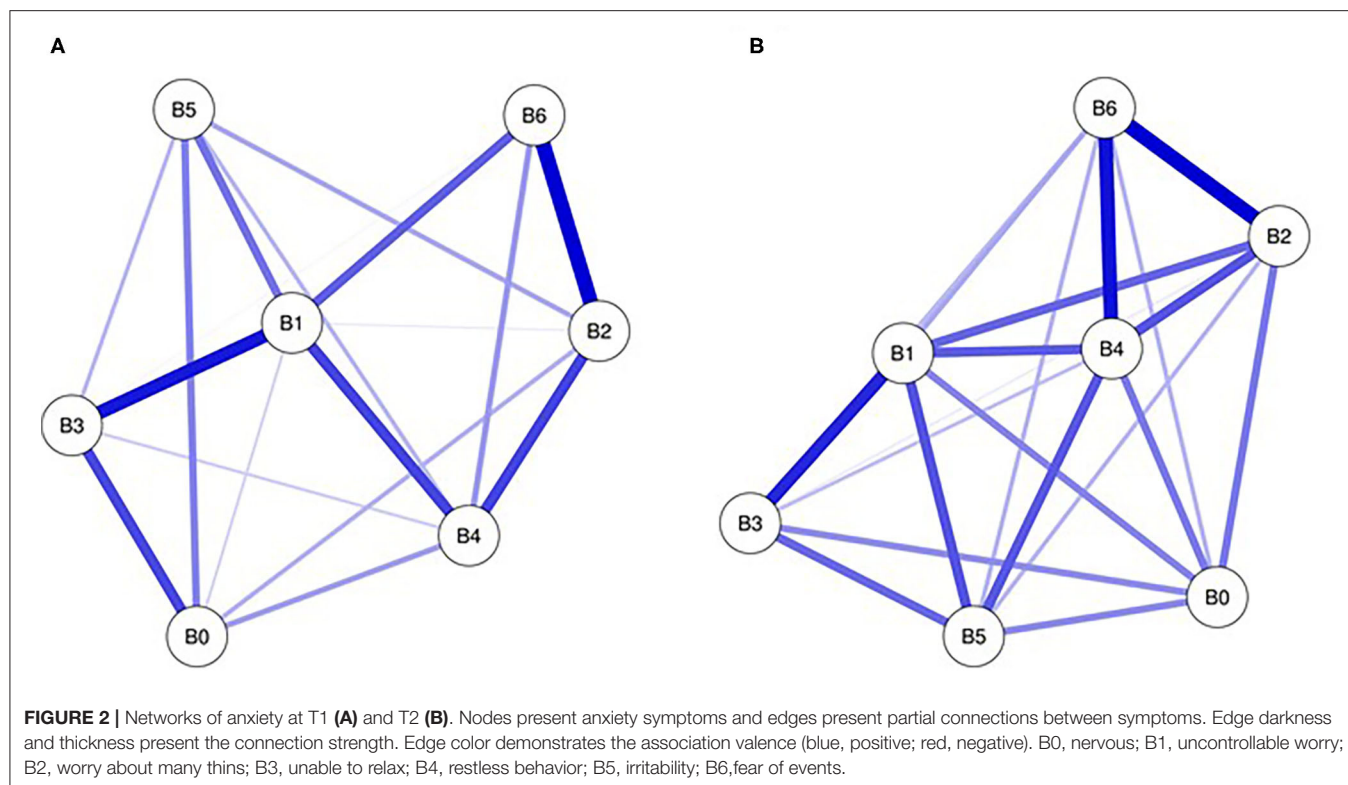
TABLE 2 | Mean symptom severity scores at T1 and T2.

Symptoms	Mean (SD) scores	
	T1	T2
Depression symptoms		
Anhedonia (C0)	1.41 $\pm$ 0.93	1.56 $\pm$ 0.82
Depressed mood (C1)	1.67 $\pm$ 0.77	1.68 $\pm$ 0.70
Sleep disturbance (C2)	1.70 $\pm$ 0.65	1.78 $\pm$ 0.57
Low energy (C3)	1.56 $\pm$ 0.89	1.56 $\pm$ 0.84
Change in appetite (C4)	1.34 $\pm$ 0.95	1.36 $\pm$ 0.88
Worthless (C5)	1.24 $\pm$ 0.97	1.33 $\pm$ 0.90
Low concentration (C6)	1.38 $\pm$ 0.92	1.46 $\pm$ 0.80
Psychomotor agitation/retardation (C7)	1.25 $\pm$ 1.02	1.37 $\pm$ 0.93
Suicide ideation (C8)	1.38 $\pm$ 0.97	1.48 $\pm$ 0.87
Anxiety symptoms		
Nervous (B0)	1.44 $\pm$ 0.81	1.50 $\pm$ 0.82
Uncontrollable worry (B1)	1.34 $\pm$ 0.91	1.42 $\pm$ 0.88
Worry about many things (B2)	1.26 $\pm$ 0.93	1.36 $\pm$ 0.91
Unable to relax (B3)	1.50 $\pm$ 0.79	1.62 $\pm$ 0.74
Restless behavior (B4)	1.18 $\pm$ 0.90	1.30 $\pm$ 0.90
Irritability (B5)	1.20 $\pm$ 0.96	1.38 $\pm$ 0.93
Fear of awful events (B6)	1.32 $\pm$ 0.86	1.44 $\pm$ 0.84
Sleep symptoms		
Difficulty falling asleep (A0)	2.32 $\pm$ 1.00	2.36 $\pm$ 1.01
Easy wake up (A1)	2.68 $\pm$ 0.76	2.70 $\pm$ 0.76
Go to the toilet frequently (A2)	2.00 $\pm$ 0.86	1.93 $\pm$ 0.90
Cannot breathe comfortably (A3)	2.09 $\pm$ 1.11	2.02 $\pm$ 1.15
Cough or snore (A4)	0.11 $\pm$ 0.53	0.13 $\pm$ 0.56
Feel cold (A5)	2.50 $\pm$ 0.86	2.49 $\pm$ 0.90
Feel hot (A6)	1.34 $\pm$ 1.09	1.32 $\pm$ 1.07
Nightmare (A7)	1.65 $\pm$ 0.91	1.44 $\pm$ 1.07
Somatic discomfort (A8)	1.37 $\pm$ 1.17	1.33 $\pm$ 1.13
Other reasons influence you sleep (A9)	2.39 $\pm$ 0.95	2.40 $\pm$ 0.99
The frequency of using medicine (A10)	2.68 $\pm$ 0.75	2.72 $\pm$ 0.72
Feel sleepy (A11)	2.14 $\pm$ 1.06	2.10 $\pm$ 1.08

RESULTS

Descriptive Statistics

We included 1,978, 1,547, and 2,061 individuals who completed depression, anxiety, and sleep assessments, respectively, at two stages. The basic characteristics are shown in **Table 1**. **Table 2** demonstrates the mean symptom severity scores for each symptom at T1 and T2.



of the impact of the COVID-19. The change in dynamic network structure and in core characteristics can also reflect the severity of their impact from another perspective.

Our results demonstrated that high centrality symptoms vary differently before and during the epidemic. Before the epidemic, worthless depression networks (C5) had high centrality, consistent with previous studies (28, 29). During

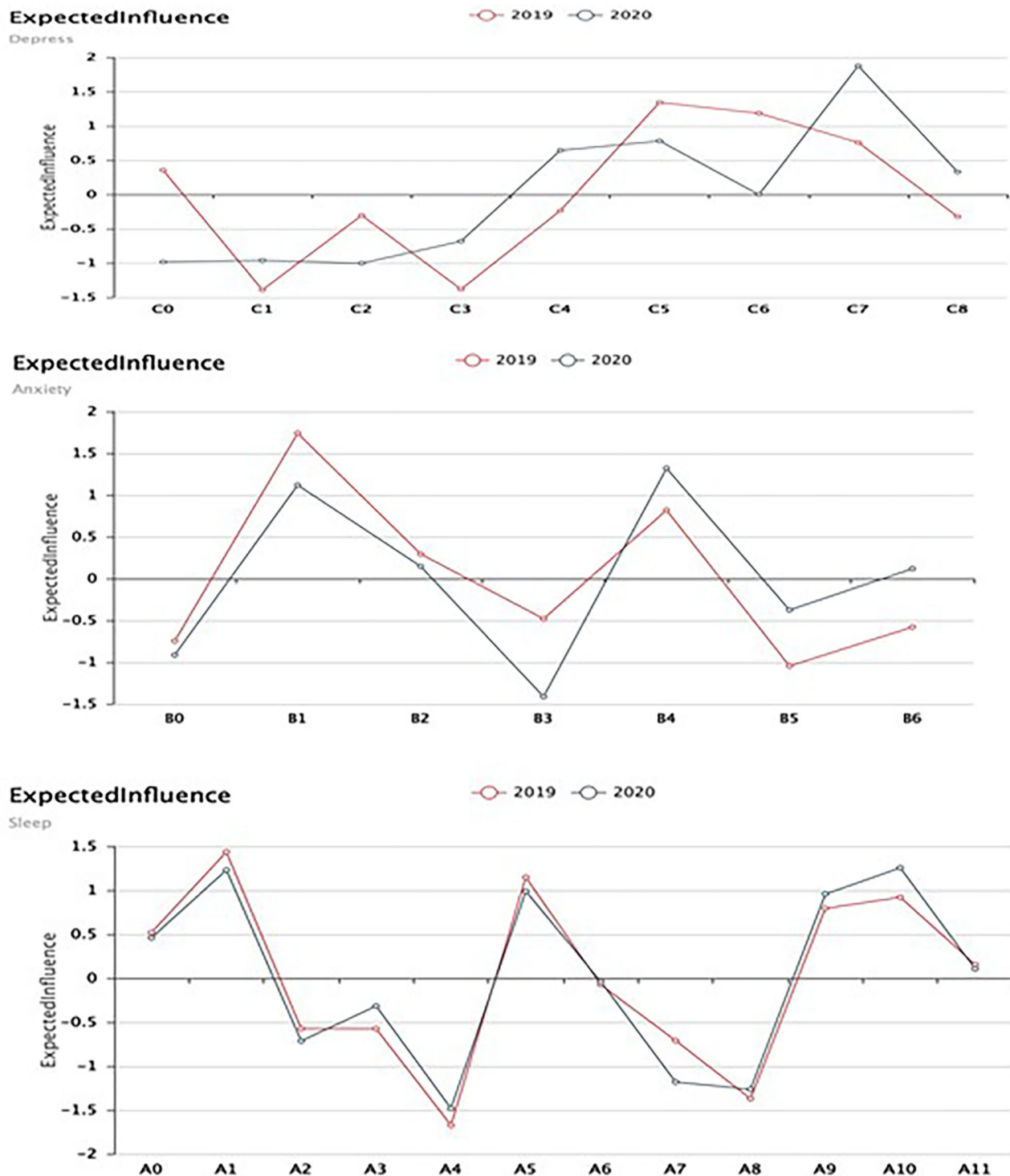


FIGURE 4 | Expected influence of depression, anxiety, and sleep symptoms. C0, anhedonia; C1, depressed mood; C2, sleep disturbance; C3, low energy; C4, change in appetite; C5, worthless; C6, low concentration; C7, psychomotor agitation/retardation; C8, suicide ideation. B0, nervous; B1, uncontrollable worry; B2, worry about many things; B3, unable to relax; B4, restless behavior; B5, irritability; B6, fear of events A0, difficulty falling asleep; A1, easy wake up; A2, go to the toilet frequently; A3, cannot breathe comfortably; A4, cough or snore; A5, feel cold; A6, feel hot; A7, nightmare; A8, somatic discomfort; A9, other reasons influence you sleep; A10, the frequency of using medicine; A11, felling sleepy.

the epidemic, psychomotor agitation/retardation (C7) has a larger influence on the spread of other symptoms and has become a hallmark symptom of depression. Psychomotor agitation/retardation (C7), as bridge symptoms, tightly connects the three dimensions of depression that included cognition (worthless, C5; low concentration, C6; and suicide ideation, C8), somatic symptoms (change in appetite, C4), and mood (anhedonia, C0). Compared with before the epidemic, this loop is connected more strongly. Helplessness, hopelessness, and worthlessness are hallmark symptoms that conceptualized depression. Boschloo's finds that these symptoms are in high centrality with network approach (30). Our result is different from that. The importance of psychomotor agitation/retardation (C7) in the depression network structure may be due to quarantine and lockdown strategies, which were implemented in some countries. Individuals may feel socially isolated, especially if they live alone or are in a community setting that does not allow visitors because of the outbreak. Disruptions to daily life and limited social activities may also lead to boredom (5). Boredom could in turn lead to psychomotor agitation/retardation (C7), that is, boredom and psychomotor agitation/retardation affect each other.

Before the epidemic, uncontrollable worry (B1) had the highest centrality for the anxiety network. This finding is consistent with common conceptualizations of anxiety and uncontrollable worry regarded as core symptoms (31, 32). During the epidemic, symptoms of inability to relax (B3) and restless behavior (B4) play an important role in the network structure. Stronger connections between several anxiety symptoms were observed. In particular, inability to relax (B3) was linked to a variety of other anxiety symptoms. Inability to relax (B3) and restless behavior (B4) may be caused by confusing, stressful times for all of us. We are all feeling uncertain about what could happen in the coming weeks, as we hope to slow the spread of this pandemic. In this survey, the average age of the participants was ~30 years old. In the Chinese culture, people at this age not only have the responsibility of raising their children but also have the responsibility for taking care of their parents. The sudden epidemic has forced them to stay at home, and reduced income may leave them in a state where they are unable to relax (B3).

There is no study to explore the network structure of sleep symptoms. Before and during the epidemic, we found that easy wake-up (A1) and the frequency of using medicine (A10) have a positive connection. Symptoms of easy wake-up (A1) and feeling cold (A5) also have high centrality. During the epidemic, symptoms of easy wake-up, the frequency of using medicine, feeling cold, and difficulty falling asleep (A0:A5:A1:A10) were connected more strongly. It is worth noting that an increasing number of individuals choose to use medicine to promote sleep quality during the epidemic. One possible explanation is that psychological changes are often accompanied by increased sleep disturbance. During this unique period, to alleviate the psychical and/or psychological problems caused by sleep disturbance, individuals are more inclined to use medicines.

During the epidemic, overall global connectivity was greater than before the epidemic, demonstrating larger associations among symptoms. The results suggest that individuals may

become more sensitive to the external environment. Before the epidemic, for the general population, most of the symptoms were dormant. Trigger events (COVID-2019) in the external field lead to network activation. Thus, successful early intervention targeting high centrality symptoms would likely prevent the full syndrome of depression/anxiety/sleep disturbance from emerging (33). However, the interpretation of the results should also be cautious. We do not consider Berkson's bias when comparing network structure between samples with different mean symptom severities (34). Berkson's bias may lead to weaker global connectivity among samples affected by more-severe symptoms compared with less-affected samples.

What intervention strategy do the results offer? Network analysis can be used to demonstrate which symptoms should be prioritized. We identified several high centrality symptoms during the epidemic. These results play an important role in developing appropriate treatments for the general population. Compared with the SARS epidemic, during the COVID-2019 outbreak, multiple online mental health services through WeChat/Weibo were provided for the general population (18). To more efficiently allocate limited medical resources and improve the effectiveness of interventions, we can prioritize high centrality symptoms (e.g., psychomotor agitation/retardation, inability to relax, and restless behavior). However, even though suicide ideation has low centrality, it should also be given more attention (35). Barbisch et al.'s (36) study found that the rate of suicidal behavior increased during the SARS epidemic. In addition to intervening nodes, weakening edges and changing circumstances reduce the stressors that may contribute to recovery (37). Specifically, we can also intervene in the connections between symptoms (e.g., the connection between easy wake-up, the frequency of using medicine, and difficulty falling asleep) (37). Although we cannot eliminate external events (COVID-19) immediately, we can increase the transparency of information and allow the general population to have a correct understanding of COVID-19.

Although we cannot eliminate external events (COVID-19) immediately, there are substantial measures that we can take. For the authorities, they should improve transparency of information and allow the general population have a correct understanding of COVID-19. It can obviously help to remove restlessness originated by uncertainty. For psychological professionals, we suggest they could help to provide a more centrally coordinated and more efficient support according to our results. For the general public, according to a recent research (38), we recommend several measures such as chatting with friends online, meditation-based programs, singing, and yoga to release the stress and relax the mind.

There are several limitations in the research. First, we employed the snowball strategy due to limited resources. The snowball strategy was not according to a random selection sample, and participants did not reflect the actual mental health of the general population. Moreover, it is cautious that marital and social status data were only collected on T2 stage. As high level of social support is significantly associated with low levels of depression and anxiety (39) and favorable sleep outcomes (40), marital and social status may influence the symptoms that we

evaluated. Thus, more research efforts are needed upon this issue in the near future. Second, we used self-reported questionnaires (PHQ-9, GAD-7, and PSQI) in this research. Response bias and recall bias may exist considering that the general population may have underreported or overreported their depression, anxiety, and/or sleep symptoms. We took some measures to decrease this by keeping uniformity of the data collection method. Although Cronbach's alpha was lower (ranging from 0.6 to 0.7) in our research, it indicates an acceptable level of reliability (41, 42). This may be due to the population's being heterogeneous (42). Third, people with preexisting mental health conditions, people at higher risk for severe illness, and people with underlying health conditions can also confound the results. It is worth mentioning that sense of safety after recovery from COVID-19 may be relevant to the symptoms assessed in our research. However, by 8 March 2020, the number of living cases of COVID-19 in China is 77,759 (43), i.e., <0.06‰ of the national population. Taking our sample size into consideration, we were not likely to include statistically significant participants that had recovered from COVID-19 although the snowball sampling was chosen. The future study may enlarge the sample size and explore the relationship between history of COVID-19 in participants and symptoms. Fourth, our data were taken from different seasons (winter and spring). Some evidence shows that mood disorder may be influenced by seasonality (44, 45), and we did not consider the influence of season on mood state.

CONCLUSION

The present research was the first to explore the dynamic network structure of depression, anxiety, and sleep symptoms before and during the COVID-19 epidemic. From the network perspective, we can understand how this epidemic triggered and activated symptoms. The results demonstrated that symptoms of psychomotor agitation/retardation (C7), inability to relax (B3), and restless behavior (B4) should be treated preferentially. In addition, we should also pay attention to the way patients use medicines to promote sleep quality. The first is that sleep disturbance becomes less self-regulating. On the other hand, we

also need to think about any psychosocial interventions that can improve sleep and avoid unreasonable use of medicines. Global connectivity is stronger than before the epidemic, which suggests that timely and effective intervention is necessary.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Medical Ethics Committee of Sichuan University. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

FG: interpretation of data, drafting the manuscript. AZ: analysis and interpretation of data. MW: drafting the manuscript. GL: acquisition of data. JZ: conception and design of study, revising the manuscript critically for important intellectual content. All authors contributed to the article and approved the submitted version.

FUNDING

This work was supported by Key Research Project, Science & Technology Department of Sichuan Province (no. 2020YFS0232) and Emergency Project for Post Earthquake Reconstruction, Sichuan University (no. 2013SCU190).

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2021.591656/full#supplementary-material>

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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A Fear of COVID-19 and PTSD Symptoms in Pathological Personality: The Mediating Effect of Dissociation and Emotion Dysregulation

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OPEN ACCESS

Edited by:

Paola Aceto,
Catholic University of the Sacred
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Reviewed by:

Stefania Cataudella,
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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 31 July 2020

Accepted: 12 February 2021

Published: 23 March 2021

Citation:

Velotti P, Civilla C, Rogier G and
Beomonte Zobel S (2021) A Fear of
COVID-19 and PTSD Symptoms in
Pathological Personality: The
Mediating Effect of Dissociation and
Emotion Dysregulation.
Front. Psychiatry 12:590021.
doi: 10.3389/fpsy.2021.590021

Background: The 2019 coronavirus disease (COVID-19) outbreak is currently putting a strain on the mental health resilience of the world's population. Specifically, it is likely to elicit an intense response to fear and to act as a risk factor for the onset of posttraumatic stress disorder (PTSD). Some individuals may be more at risk than others, with pathological personality variables being a potential candidate as a central vulnerability factor. In addition, the pathways that lead the pathological personality to PTSD and intense fear responses to COVID-19 are likely to be explained by poor emotion regulation capacities, as well as by dissociative mechanisms.

Aims: This study aimed to shed light on vulnerability factors that may account for the onset of PTSD and intense responses of fear in response to COVID-19 outbreak and to test the mediating role of emotion dysregulation and dissociation proneness in these pathways.

Methods: We used a longitudinal design of research administered to a sample of community individuals ($N = 308$; $\text{mean}_{\text{age}} = 35.31$, $SD = 13.91$; 22.7% were male). Moreover, we used self-report questionnaires to measure pathological personality, emotion regulation capacities, dissociative proneness at the beginning of the lockdown, and PTSD symptoms and fear of COVID-19 at the end of the Italian lockdown (from March 9 to May 18, 2020). Structural equation modeling was used to test the hypotheses.

Results: We found that pathological personality levels longitudinally predicted PTSD and fear of COVID-19 levels. Moreover, the associations between emotion dysregulation and dissociation were shown to significantly and totally mediate the relationship between pathological personality and PTSD, whereas no significant mediation effects were observed in relation to fear of COVID-19.

Conclusions: Individuals with pathological personality traits may be more vulnerable to the onset of negative psychological consequences related to COVID-19 outbreak, such as PTSD symptomatology and fear levels. Emotion regulation capacities appear to be relevant targets of interventions for PTSD symptomatology. Future research should explore the mediating variables linking pathological personality to intense fear responses to COVID-19.

Keywords: fear of COVID-19, posttraumatic stress disorder, emotion dysregulation, pathological personality, longitudinal, dissociation

INTRODUCTION

According to the World Health Organization (1), the new coronavirus disease (COVID-19), which appeared at the end of the 2019, is responsible for more than 1,633,941 deaths and 73,453,006 confirmed cases (December 15, 2020). Most nations have been forced to implement restrictive rules to protect citizens' health, such as "stay-home" indications, preventing individuals from moving freely, which often implied the impossibility of physically interacting with their significant others. In particular in Italy, given the rapid spread of the virus over the entire peninsula, a total lockdown was established (with the closure of commercial activities and services and ban on free movement) from March 9 to May 18, 2020. It seems reasonable to suggest that this situation may have induced relational and social difficulties (2). Moreover, this serious scenario could also be worsened by an amplification of fear (3), by media or social networks, spreading panic or fake news, or by false-positive diagnosis (for instance, in India, a family man committed suicide to protect his family following a false-positive diagnosis of COVID-19). Fear can be dangerous, especially for subjects with previous psychopathological vulnerability, such as pathological personality traits: studies examining basic biological mechanisms support the idea that emotion dysregulation increases fear levels (4), through the connection between emotional dysregulation and lack of tolerance. In addition, the relationship between anxious personality levels and the tendency to generalize fear in new situations (i.e., toward stimuli with perceptual or conceptual similarities to an original fearing stimulus) has been confirmed by different researches (5–8).

Some authors (9) have reviewed the hypothesis that fear experienced during a traumatic event, followed by repeated memories related to it, may lead to a sensitization of the response to fear with a consequent heightened psychophysiological reactivity. In fact, recent studies conducted during the COVID-19 outbreak pointed out the psychological consequences of the pandemic, such as emotional disturbances, depression, anger, insomnia, and emotional exhaustion triggered by fear and isolation (10). In some cases, the pandemic was experienced as a real traumatic event, and some studies have found that it led to the development of posttraumatic stress disorder (PTSD) in both Italian and world population (11–14) as other dramatic events studied before (15, 16). PTSD, diagnosed for the first time in war survivors and known as "battle fatigue," has been widely studied in all populations who have experienced traumatic events, such

as natural disasters, terrorist attacks, car accidents, sexual abuse, and death of loved ones (17).

PTSD is classified within the section Disorders Related to Traumatic and Stressful Events (American Psychiatric Association, 2013), and its onset occurs after the exposure to a traumatic or stressful event. PTSD consists of symptomatologic manifestations, such as dissociative reactions, recurrent intrusive memories, avoidance of trauma-related stimuli, and negative alteration of emotions associated with the event. Recently, some authors have hypothesized a correlation between PTSD and pathological personality, intended as a disturbance that fundamentally involves dysregulation and/or distortions in both proximal and internal interpersonal situations (18). An increased interest in the study of pathological personality allowed the creation of diagnostic manuals over the years, aiming to describe the plurality of personality disorders and their characteristic features. The frequency of personality disorders in general adult population has been estimated to be approximately 12.16% and to be three times higher among clinical populations (19). Personality disorders greatly affect the costs of public health, as individuals who suffer from these disorders often show great difficulties in their social, work, and interpersonal functioning (20). These costs are likely to increase when worldwide population is struggling with a severe blow, such as the COVID-19 outbreak.

A group of researchers (21) investigating the relationship between PTSD, posttraumatic beliefs, and personality traits in subjects who had experienced disasters found that pathological personality was positively related to PTSD symptoms. In particular, individuals with PTSD showed high levels of mood instability and grandiosity traits. Another line of research (22–24) investigated the association between borderline personality disorder (BPD) and PTSD and hypothesized a common etiology that focuses on the associations between childhood trauma, particularly childhood sexual abuse, and both BPD and PTSD. The results showed that some key characteristics of the two disorders, such as affective instability, cognitive/perceptual disorders, and interpersonal dysfunctions, overlapped (25–27). James et al. (28) observed that a group of veterans with PTSD showed higher levels of pathological personality [measured using the Personality Inventory for *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5)*] than another group of veterans without PTSD. Specifically, the most problematic domains were those related to psychoticism, detachment, disinhibition, and negative affection. According to the authors,

this study emphasizes the importance of pathological personality in PTSD, paving the way for new research aiming at evaluating the role of maladaptive personality traits in PTSD comorbidities.

Currently, the best way to prevent COVID-19 is to avoid being exposed to the virus. However, a scenario characterized by the need to wear gloves and masks and the lack of any effective available therapy may lead to an uncontrolled spread of fear. A fear response, as a basic physiological condition, occurs when there is a threat, whether real or perceived. Its role is to prepare the body to respond to this threat. However, if there is a dysfunction in the processing of fear, it can lead to the development of psychiatric symptomatology (29). LeDoux (30, 31), who has extensively studied fear and the role of the amygdala, has identified three ways by which individuals react to frightening stimuli. The fastest circuit is the “primitive” one, which puts in place an immediate fight-and-flight response; the “rational” circuit is slower and allows the individual to consider the situation in a more realistic way; the “reflective” circuit is characterized by the awareness of being afraid. The primitive circuit guarantees survival; however, if the frightening stimulus is far enough, the rational circuit is activated, helping to rationalize what is happening. The rational circuit is not as immediate as the primitive circuit and does not always work properly, which is why emotions sometimes take over. Another important contribution comes from Porges’ polyvagal theory (32). The author asserted that three levels of activation exist as a function of environmental conditions: a “safe environmental situation,” in which social interaction acts as a mediator of autonomic modulation and in which the systems of attachment and socialization are facilitated; a “situation of insecure environment,” which causes active avoidance reactions that provide the possibility to attack or escape in an adaptive way; a “life-threatening situation,” which is a condition wherein the threat is so overwhelming that the reactions activated are mostly characterized by passive avoidance, such as freezing, dissociation, tonic immobility, and feigned death (32). All these studies converge on the idea that dissociation can be a form of emotion regulation that is used to cope with various stressful situations (33). Moreover, several authors have conceptualized dissociation as an experiential avoidance strategy that aims to decrease awareness or the processing of painful affects (34); therefore, it confirms it is deeply connected to emotion regulation abilities.

EMOTION DYSREGULATION AND DISSOCIATION IN PTSD

In the third level of activation of Porges’ polyvagal theory, the individual implements a dysfunctional modality to regulate emotional arousal and may use dissociation. The proposed *DSM-5* criteria for PTSD conceptualize the disorder as a mere response to fear and include dysregulation of negative emotions, including anger, guilt and shame, and dissociation. Dissociation plays an important role in PTSD, inducing disruptions in the integrated functions of memory, identity, and perception of oneself and the environment (26, 33, 35).

Furthermore, research has shown that poor emotion regulation exacerbates PTSD symptoms (36), suggesting that emotion dysregulation is a mechanism that emphasizes or makes them chronic (33). According to Gratz and Roemer (37), emotion regulation in adulthood can be considered as a multidimensional construct that includes awareness, understanding, and acceptance of emotions. It promotes the ability to control impulsive behaviors and to implement goal-directed behaviors when experiencing negative emotions, guaranteeing the use of situational strategies to modulate the intensity and the duration of emotional responses, instead of completely eliminating them (38).

The difficulty in regulating emotions is connected to a series of maladaptive behaviors (39), such as addiction, promiscuous sexual behavior, and self-harm (40–44), as well as several psychopathologies (45), such as BPD, PTSD, or generalized anxiety disorder. Studies on patients with BPD have shown that emotion dysregulation seems to develop simultaneously with dissociative features (46). In addition, Briere (47) conducted a study on traumatized patients and found a relationship between PTSD, emotion regulation, and dissociation. Even though these results suggest a link between emotion regulation and PTSD, to date few studies have examined the interplay between emotion dysregulation and dissociation in PTSD (48).

THE CURRENT STUDY

As the variables of fear, personality, emotional dysregulation, and PTSD are extremely interrelated with each other, it seemed important to us to study them jointly during the COVID-19 pandemic in order to better understand the mechanisms that bind them. Thus, the purpose of this study was to investigate the population subjected to “stay-home” measures related to the COVID-19 outbreak, and the hypothesis is therefore that personality pathology severity predicts PTSD and fear of COVID-19 and that these relationships may be mediated by emotion dysregulation and dissociation.

Therefore, beyond the importance of examining this relationship within the context of the pandemic, this study aimed to provide useful evidence to fill the gap in literature on the interplay between personality, PTSD, and emotion dysregulation.

METHODS

Participants and Procedure

All participants were recruited through an online survey distributed 3 days after the beginning of the lockdown (Time 1). A presentation letter at the beginning of the survey explained the aims and scopes of the study and illustrated information regarding anonymity and privacy. Then, participants were invited to provide an informed written consent and to fill in a battery of self-report questionnaires. Lastly, an email was sent to each participant 3 days before the end of the lockdown (Time 2), asking to complete the procedure through the answering of additional self-report questionnaires. The whole procedure was

approved by the ethics committee of the University of Rome, Sapienza (N. 356/20).

At the survey at Time 1, 1,323 subjects responded ($\text{mean}_{\text{age}} = 35.38$, $\text{SD} = 14.08$); 23% of the sample were male; 52.3% had achieved a level of education higher than high school diploma, but nearly half of the sample reported having an income of <€36,000 per year. As for romantic relationships, 33.7% said they were not involved in any relationship, and 26.5% of them reported having one or more children. For the purpose of the study, only participants who completed the two batteries of self-report questionnaires (at Time 1 and Time 2) were considered. The final sample consisted of 308 adults ($\text{mean}_{\text{age}} = 35.31$, $\text{SD} = 13.91$; 22.7% males). Among them, 44.3% obtained a college degree, and nearly half (47%) had an income per year inferior to €36,000. In addition, most were not involved in any romantic relationship (23%), and only 24.4% of the sample reported to have children.

MEASURES

The battery of self-report questionnaires administered at Time 1 consisted of the following:

- a questionnaire asking for demographic information such as age, gender, and economical incomes;
- emotion dysregulation levels were measured through the *Difficulties in Emotion Regulation Scale* [DERS; (37, 49)]. This is a self-report questionnaire of 36 items asking the participant to answer on a Likert-type scale ranging from 1 (never) to 5 (always). It provides not only a total score but also subscores corresponding to the six dimensions of emotional dysregulation evaluated by the instrument, namely, (i) nonacceptance (the difficulty to accept negative emotions in a nonjudgmental way), (ii) goals (the deficit in the ability to pursue goal-directed behavior when experiencing negative emotions), (iii) impulse (the tendency to act in a rush when experiencing negative emotions), (iv) awareness (the lack of awareness of one's negative emotional states), (v) clarity (the difficulty to discriminate between negative emotional states) and strategies (the perceived lack of available and effective emotion regulation strategies to regulate negative emotions);
- dissociative experiences were evaluated throughout the Dissociative Experiences Scale II [DES-II; (50, 51)]. This instrument is a 28-item self-report questionnaire asking the participant to evaluate the frequency by which some dissociative experiences occur in his life on an 11-point Likert-type scale ranging from 0% (never) to 100% (always). The instrument provides a total score and two scores corresponding to the two subscales of the questionnaire being detachment and compartmentalization;
- pathological personality was assessed with the Pathological Inventory for DSM-5, short version [PID-5; (52, 53)]. This self-report questionnaire consists of 25 items asking the participant to answer on a 4-point Likert-type scale ranging from 0 (always or often false) to 3 (always or often true). The instrument provides five scores corresponding to the main five pathological domains of personality identified by

DSM-5. These are negative affect, disinhibition, antagonism, detachment, and psychoticism.

At Time 2, participants were asked to fulfill other self-report questionnaires evaluating the following variables:

- PTSD symptom severity, assessed throughout the National Stressful Events Survey PTSD Short Scale (NSESSS), a 9-item instrument developed by LeBeau et al. (54). It asks to answer to each item on a 5-point Likert-type scale, with answers potentially ranging from 0 (not at all) to 4 (extremely). This provides a total score assessing the severity of PTSD symptoms. We adapted the version of this instrument asking the participant to evaluate only stressful events related to the emergency situation derived from the onset of COVID-19, specifying in the questionnaire submission: "In the past 2 weeks, how disturbed you have been with each of the following problems that began or worsened following an extremely stressful event or experience related to the COVID-19 pandemic?"
- fear of COVID-19, measured throughout the Fear of COVID-19 Scale [FCV-19S; (55, 56)]. This self-report questionnaire asks the participant to indicate the intensity of seven experiences related to the experience of fear linked to COVID-19, answering on a 5-point Likert type scale. The scale was constructed from an extensive literature review of all general fear scales tested across different populations and diseases. To date, the instrument has been translated and validated in more than 19 languages, and its predictive power on anxiety, health anxiety, and PTSD symptoms has been confirmed by several studies (57).

STATISTICAL ANALYSES

To reach the aims of the study, we first explored bivariate correlations between all variables included in the study, throughout the calculation of r Pearson coefficients. Then, we designed and tested a structural equation modeling. First, latent variables were created using manifest variables. Specifically, pathological personality latent variable was the result of the convergence of the scores obtained on the five subscales of the PID-5. Emotion dysregulation latent variables resulted from the convergence of the six scores obtained on the six subscales of the DERS. Similarly, dissociation latent variable was created using the scores obtained on the subscales of DES-II. Finally, fear of COVID-19 and PTSD symptomatology were two latent variables created using the scores obtained on the items of FCV-19S scale and NSESSS, respectively.

The structural model has been designed specifying paths between independent variable (pathological personality), mediators (dissociation and emotion dysregulation), and outcomes (fear of COVID-19 and PTSD symptoms). As age resulted to be significantly correlated with our outcomes, we decided to include it as a covariate in the structural model.

To design and test our model, we used the lavaan package of the R software for Mac. The method used evaluates the consistency of a dataset with a model previously

defined throughout the robust maximum likelihood method of estimation. Results brought by these statistical analyses are examined using several goodness-of-fit indexes, such as root mean square error of approximation (RMSEA), Tucker–Lewis coefficient (TLI), and comparative fit index (CFI). A $0.05 < \text{RMSEA} < 0.08$ (58) and both TLI and CFI being > 0.90 (59) are generally interpreted as an adequate fit. In addition, we examined the lower and upper boundaries of the 90% confidence interval for RMSEA, with an upper boundary of more than 0.10, indicating that the model should be rejected (58).

RESULTS

Correlations Between Variables

We calculated the r Pearson correlations between all variables involved in the study at Time 1. The results are fully displayed in **Table 1**.

STRUCTURAL EQUATION MODEL

The test of the first model brought an acceptable fit according the RMSEA index [0.069; 90% confidence interval (CI) (0.064–0.075)], but the CFI index was considered below the acceptable cutoff (0.87). Thus, we respecified the model using the modification indexes suggested by the software. In particular, we added the estimation of some parameters, including the covariance between residual errors between the PTSD (Item 2 and Items 1 and 3) and FEAR items (2 and 5; 1 and 4), and the clarity and awareness dimension of the emotion dysregulation variables. These respecifications allowed us to reach an acceptable fit for the model on both the RMSEA [0.060; 90% CI (0.054–0.066)] and CFI index (0.90). The final model, as illustrated in **Figure 1**, indicates that pathological personality positively and significantly predicted the level of fear of COVID-19. However, this effect was not mediated by emotion dysregulation ($\beta < 0.05$; $p = 0.616$) nor dissociative features ($\beta < 0.02$; $p = 0.745$). In contrast, the relationship between pathological personality and PTSD symptoms was totally mediated by both

emotion dysregulation ($\beta < 0.51$; $p .001$) and dissociation ($\beta < 0.45$; $p .001$).

DISCUSSION

In the present study, we tried to understand the relationship between pathological personality, PTSD, and fear of COVID-19. Furthermore, we investigated whether and how emotion dysregulation and dissociation mediate the relationship between these variables.

First, the results confirmed a direct relationship between pathological personality and fear of COVID-19, which is consistent with results brought by literature that hypothesized and observed among clinical samples that individuals with an anxious personality showed higher fear scores (5).

Second, the results confirmed a direct relationship between pathological personality and PTSD, which is consistent with our hypotheses and the results brought by literature. For instance, Reis et al. (21), in a study conducted on individuals who experienced disasters, found a positive and significant correlation between pathological personality and PTSD levels.

For both pathways, we assumed the existence of intervening mediators, such as emotion dysregulation and dissociation. Regarding the relationship between pathological personality and fear of COVID-19, our results did not confirm that dissociation and emotion dysregulation were involved in the relationship between the two variables. Thus, we think that other intervening mediators, which are not examined in the study, may better explain this relationship. For example, Reis et al. (21) underlined the role of specific variables, such as grandiosity and unstable mood. On the contrary, in the relationship between pathological personality and PTSD, the results highlight the important role of emotion dysregulation and dissociation, supporting the results of previous studies (47, 48). Indeed, many authors have studied PTSD and its comorbidity with personality disorders: for instance, Briere (47) and other researchers have become interested in the role played by dissociation and

TABLE 1 | Correlations between main variables of the study.

	PID NA	PID DET	PID ANT	PID DIS	PID PSY	DERS	DESdet	DEScomp	PTSD	FEAR	Age
PID NA	–										
PID DET	0.53**	–									
PID ANT	0.27**	0.44**	–								
PID DIS	0.39**	0.41**	0.29**	–							
PID PSY	0.60**	0.58**	0.37**	0.42**	–						
DERS	0.52**	0.56**	0.29**	0.36**	0.54**	–					
DESdet	0.31**	0.34**	0.21**	0.35**	0.44**	0.36**	–				
DEScomp	0.35**	0.38**	0.24**	0.35**	0.50**	0.39**	0.75**	–			
PTSD	0.42**	0.40**	0.21**	0.30**	0.44**	0.51**	0.48**	0.55**	–		
FEAR	–0.28**	–0.15*	–0.08	–0.01	–0.25**	–0.29**	–0.11	–0.21**	0.22**	–	
Age	–0.28**	–0.15*	–0.08	–0.01	–0.25**	–0.29**	–0.11	–0.21**	–0.22**	–0.11*	–

PID, Pathological Inventory for DSM-5; NA, Negative Affect; DET, Detachment; DIS, Disinhibition; PSY, Psychoticism; DERS, Difficulties in Emotion Regulation Scale; DEScomp, Dissociative Experience Scale 2nd Version Compartmentalization; DESdet, Dissociative Experience Scale 2nd Version Detachment scale; PTSD, Post Traumatic Stress Symptoms; FEAR, Fear of COVID-19; ** $p < 0.001$; * $p < 0.05$.

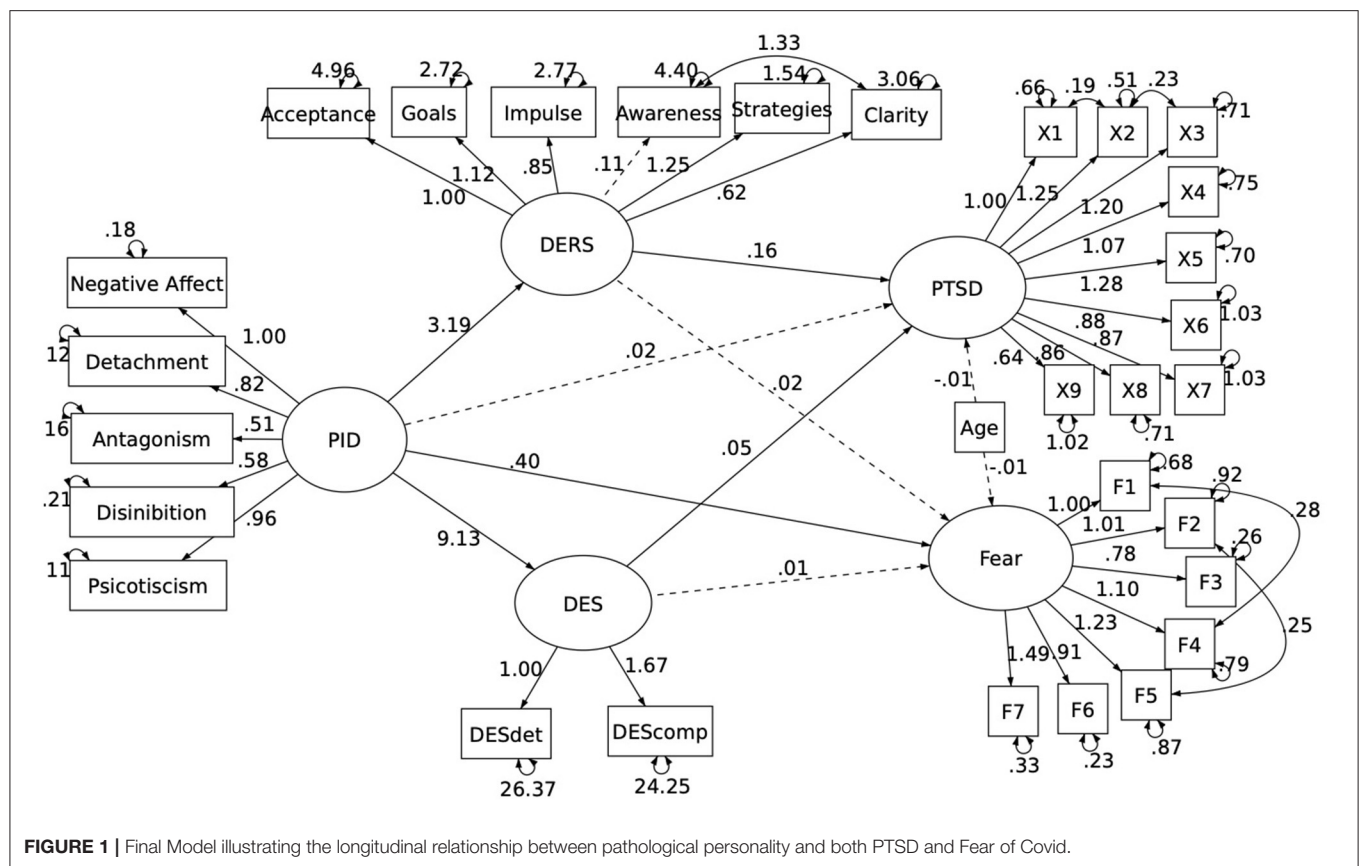


FIGURE 1 | Final Model illustrating the longitudinal relationship between pathological personality and both PTSD and Fear of Covid.

dysregulation of emotions in PTSD and fear, whereas Van Dijke et al. (60) assert that exposure to trauma or a series of trauma leads to the development of posttraumatic symptoms and development of personality disorders. Furthermore, they hypothesized that in the event that elicits a posttraumatic complex stress disorder, some factors, such as poor emotion regulation and dissociative characteristics, can worsen the clinical picture. Thus, it can be deduced from the many studies that highlighted the strong link between pathological traits and PTSD. Furthermore, emotion dysregulation has been linked both to the development or worsening of PTSD and to the severity of other psychopathologies related to trauma. Among other things, more and more research (9, 61) supports the existence of a dissociative subtype of PTSD that has been included in the fifth edition of the DSM (62).

LIMITATIONS AND FUTURE DIRECTIONS

Our study has objective limitations that must be considered. Given social distancing rules and the inability to conduct research in any other way, we used nonprospective tools to collect data, specifically self-reports that can be filled online. Although they showed good reliability and internal consistency and provide a valid, easy, and fast assistance in the administration of diagnostic tools, self-report instruments are limiting for various reasons. First, the possibility that the constructs investigated are easily identifiable can lead to the phenomenon of social desirability,

the creation of prejudices, and therefore the falsification of answers. For this reason, the use of implicit measures to assess personality could be an excellent research starting point for the future (63). Another aspect to be taken into account is the possibility of overlooked latent variables that could have had an effect on the relationships identified. Nevertheless, what has been said can be a starting point to deepen these aspects in future research and possibly compare the results. We can therefore assert that this research may allow an opening to new considerations both on personality disorders and on the factors involved in the development of trauma: it could be very interesting to investigate the personality more broadly, perhaps making use of projective instruments, in relation to COVID trauma to identify protective factors or vulnerabilities that could promote or worsen traumatic adaptation. In addition, our study highlights that the pandemic experience (i.e., staying home and related deprivations) may have led to the onset of difficulties in general population, but even more in vulnerable individuals with pathological personality traits (61, 64–66).

Concerning possible clinical implications, this study sheds light on which could be the most relevant aspects to focus on for intervention: reading COVID-related distress in terms of PTSD could be useful for formulating specific therapeutic interventions, especially with individuals with preexisting psychopathology. The research results could therefore be used in diagnostics and exploration, as well as open new directions for further research.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Sapienza Ethics Committee. The patients/participants provided their written informed consent to participate in this study.

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AUTHOR CONTRIBUTIONS

PV design of the work and critical revised the paper. CC, GR, and SB collected data. GR analyzed data. All authors contributed to draft the article.

ACKNOWLEDGMENTS

We would like to thank the Association Soletterre for having promoted our survey on their website.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Occupational Burnout Among Frontline Health Professionals in a High-Risk Area During the COVID-19 Outbreak: A Structural Equation Model

OPEN ACCESS

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 29 June 2020

Accepted: 02 March 2021

Published: 26 March 2021

Citation:

Li D, Wang Y, Yu H, Duan Z, Peng K,
Wang N, Zhou Q, Hu X, Fang K,
Wilson A, Ou J and Wang X (2021)
Occupational Burnout Among
Frontline Health Professionals in a
High-Risk Area During the COVID-19
Outbreak: A Structural Equation
Model. *Front. Psychiatry* 12:575005.
doi: 10.3389/fpsy.2021.575005

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Background: The outbreak of coronavirus disease 2019 (COVID-19) resulted in a substantial workload and stress for frontline health professionals in high-risk areas. Little research has investigated the mechanism of occupational burnout among the frontline health professionals located in the center of the epidemic in Wuhan, China.

Methods: A total of 199 frontline health professionals from Wuhan Jinyintan Hospital completed the cross-sectional survey. Mechanisms of occupational burnout (according to the Maslach Burnout Inventory-General Survey, MBI-GS) among the health professionals in Jinyintan Hospital during the COVID-19 outbreak were examined using a structural equation model (SEM).

Results: The levels of the three burnout dimensions (emotional exhaustion, cynicism, and professional efficacy) were high at 34.2, 50.8, and 35.2%, respectively. Frontline health professionals in this stressful period reported significantly greater emotional exhaustion ($p < 0.001$) and job-related cynicism ($p < 0.001$), but no significant difference in professional efficacy ($p = 0.449$), when compared to employees in a large multinational company. The SEM results revealed that both acute stress symptoms and psychosomatic symptoms significantly predicted the emotional exhaustion and occupation cynicism dimensions of burnout.

Conclusion: The study reveals the occupational burnout mechanism of frontline health professionals during the COVID-19 peak at the time of the outbreak. This study provides an important contribution to understanding the future psychological interventions necessary for frontline health professionals during an epidemic crisis.

Keywords: health professionals, psychosomatic, acute stress, China, COVID-19 outbreak

INTRODUCTION

The coronavirus disease 2019 (COVID-19) outbreak first occurred in Wuhan, Hubei province, China in December 2019 and quickly spread nationally and internationally (1). Because of the high risk of mortality, the COVID-19 epidemic has attracted a substantial amount of public health concern and research attention (1–4). Overall, the epidemic crisis has had devastating effects and a profound impact on frontline health professionals (5). Wuhan Jinyintan Hospital is a specialist hospital for infectious disease control. According to the government arrangement during the COVID-19 outbreak, infected patients from the whole of Wuhan were allocated centrally to Jinyintan Hospital (6). In an effort to control the spread and treat the infected during the COVID-19 outbreak, health professionals faced intense workloads and a high risk of occupational exposure. They experienced great distress during the treatment of patients with COVID-19 because of the uncertainty of infection information and the rapidly changing guidelines (7).

Sufficient studies have demonstrated that working during a disease outbreak has noteworthy effects on stress levels for health professionals (8–10). It is well-documented that stress works as a significant influencing factor for burnout (11–13). Occupational burnout can be reflected in feeling overextended emotionally, feeling cynical, and having an impersonal response toward recipients of one's work, experiencing distanced attitudes toward work, and feeling a lack of accomplishment toward work (14). The association between burnout and stress is well-documented in previous research (10, 12, 15, 16). For example, during the Middle East respiratory syndrome coronavirus outbreak there was persistent stress experienced by the health professionals that led to burnout (11). Moreover, the intense interaction with patients and stress were associated with key symptoms of burnout including emotional exhaustion and depersonalization (17). Similarly, considering the workload of health professionals in Jinyintan hospital during the pandemic, the risk of burnout was elevated.

Health professionals are valuable assets for the treatment and control of the COVID-19 epidemic (18). The acute stress induced by the outbreak of COVID-19 could be an important influencing factor for burnout in frontline health professionals. Wellness of health professionals is critical for the effective management of the COVID-19 epidemic and possible future pandemics. It is vital to tend to the stress and burnout of the frontline health professionals currently facing COVID-19 in the center of the epidemic.

There are a few studies specifically focused on burnout among frontline health professionals during the COVID-19 epidemic in a high-risk area. The current study aims to investigate the relation between psychophysical variables, including acute stress symptoms and occupational burnout, in health professionals and contribute to the understanding of and future interventions for burnout during an epidemic crisis.

METHODS

Study Design and Participants

Data were collected during the COVID-19 outbreak in a high-risk area (Wuhan Jinyintan Hospital) from January 28, 2020, to February 1, 2020. The participant recruitment was led by the first author (Dan Li) from Jinyintan Hospital, who distributed the questionnaires to colleagues using convenience sampling. A total of 239 participants were invited with a response rate of 83.3%. The 199 frontline health professionals (53 male and 146 female) who participated ranged in age from 17 to 55 years (mean 34.31 ± 9.08 years), of who 65 were doctors, 110 nurses, and 24 allied health professionals. The current sample largely represented the distribution of the health professionals in Jinyintan Hospital. In addition, 71 health professionals were classified at junior level, 98 middle grade level, and 30 at senior level. The sociodemographic characteristics of the health professionals are summarized in **Table 1**. All participants were provided with information regarding the study and signed a consent form. All information provided by the participants was kept confidential. Ethics approval was obtained from the Second Xiangya Hospital of Central South University.

Materials

Maslach Burnout Inventory–General Survey

Burnout was measured by the Maslach Burnout Inventory–General Survey (MBI-GS) (14). The MBI-GS consists of 15 items, which are divided into three factors consisting of emotional exhaustion (5 items), cynicism (4 items), and professional efficacy (6 items). An example of emotional exhaustion is “I feel exhausted after a day's work,” an example of cynicism is “I doubt the meaning of my work,” and an example of professional efficacy is “I can effectively solve the problems at work.” Each item is rated by frequency on a scale of 0–6 from “never” to “every day.” The total scores of emotional exhaustion, cynicism, and professional efficacy were calculated with ranges of 0–30, 0–24, and 0–36. The cutoff points for the MBI-GS subscales were as follows: emotional exhaustion, low <9, average 9–13, high >13; cynicism, low <3, average 3–9, high >9; professional efficacy, low >30, average 18–30, high <18. Cronbach's alpha was 0.96, 0.94, and 0.96 for the three subscales, respectively. In addition, the averages of the subscale scores were calculated (ranging from 0 to 6) and compared with a large international community sample (19).

Stanford Acute Stress Reaction Questionnaire

Acute stress was measured by the Stanford Acute Stress Reaction Questionnaire (SASRQ) (20). The SASRQ consists of 30 items and one example is “I did not have the usual sense of who I am.” Participants were asked to rate their experience on a scale of 0–5 from “never” to “always.” The total score of acute stress was calculated and the range of the composite score was 0–150 (cutoff score 40). Cronbach's alpha was 0.97 in this sample.

Somatization From the Brief Symptom Inventory

Psychosomatic symptoms were measured by seven items taken from the Brief Symptom Inventory (BSI) (21). One example item is “I feel chest pain.” Participants were asked to rate their feelings on a scale of 1–4 from “not at all” to “extremely.” The total score

TABLE 1 | Sociodemographic characteristics of the health professionals.

Variables	N	%
Age (Mean $\pm$ SD)	34.31 $\pm$ 9.08	
Sex		
Male	53	26.6
Female	146	73.4
Ethnicity		
Han	194	97.5
Others	5	2.5
Marital status		
Single	41	20.6
Married	155	77.9
Others	3	1.5
Annual family income (RMB Yuan)		
<100000	96	48.2
$\geq$ 100000	103	51.8
Occupation		
Doctor	65	32.7
Nurse	110	55.3
Allied health professional	24	12.1
Occupational level		
Junior	71	35.7
Middle grade	98	49.3
Senior	30	15.1
Burnout—emotional exhaustion		
Low (<9)	90	45.2
Average (9–13)	41	20.6
High (>13)	68	34.2
Burnout—cynicism		
Low (<3)	32	16.1
Average (3–9)	66	33.2
High (>9)	101	50.8
Burnout—professional efficacy		
Low (>30)	50	25.1
Average (18–30)	79	39.7
High (<18)	70	35.2
Acute stress		
Yes	82	41.2
No	117	58.8

of physical ill feelings was calculated and ranged from 0 to 28. Cronbach's alpha was 0.94 in this sample.

STATISTICAL ANALYSIS

All analyses were carried out using R software Mac version 3.6.1. The alpha level was set to $p < 0.05$ to indicate statistical significance in all analyses. To examine the mechanism of health professional burnout, a structural equation model (SEM) was constructed using the R lavaan package (22). SEM is widely applied in the social sciences and behavioral sciences and is used to analyze structural relationships combining factor analysis and multiple regression. The SEM tested

proposed causal relationships (23). Somatization and acute stress were treated as predictors and emotional exhaustion, cynicism, and professional efficacy as outcomes. The analysis incorporated several simultaneous regression analyses and allowed correlations between theoretically related variables, in particular the three burnout subscales.

RESULTS

The demographic information and key variables of the participants are presented in **Table 1**. Overall, 41.2% of the participants had acute stress symptoms as measured by the SASRQ using the cutoff score of 40. Specifically, the levels of the three burnout dimensions (emotional exhaustion, cynicism, and professional efficacy) were high at 34.2, 50.8, and 35.2%, respectively. The composition of psychosomatic symptoms is shown in **Figure 1**. Chest pain was the most common psychosomatic symptom.

The descriptive statistics (means and standard deviations [SDs]) and the bivariate correlations of the variables used in the study are shown in **Table 2**. Mean scores of the MBI subscales from the current sample and from a large international sample published by Schutte et al. (19) were compared (**Table 3**). In the two-sample comparison analyses, based on means and SDs, the health professionals in Jinyintan Hospital reported significantly greater emotional exhaustion ($p < 0.001$) and cynicism ($p < 0.001$) than the employees from Schutte's sample (including workers from a large multinational cooperation based in Finland, Sweden, and the Netherlands); however, the reported scores for professional efficacy were not significantly different ($p = 0.449$).

To examine the mechanism of health professional burnout, a SEM (**Figure 2**) was constructed with somatization and acute stress as predictors and emotional exhaustion, cynicism, and professional efficacy as outcome variables, allowing correlations among the three factors of burnout. The SEM analysis revealed that somatization and acute stress significantly predicted emotional exhaustion and cynicism but not professional efficacy, with somatization predicting emotional exhaustion, $\beta = 0.24$, $Z = 3.32$, $p = 0.001$; acute stress predicting emotional exhaustion, $\beta = 0.50$, $Z = 7.06$, $p < 0.001$; somatization predicting cynicism, $\beta = 0.27$, $Z = 3.47$, $p = 0.001$; and acute stress predicting cynicism, $\beta = 0.38$, $Z = 4.85$, $p < 0.001$. In addition, emotional exhaustion and cynicism were significantly correlated ($r = 0.50$, $Z = 6.33$, $p < 0.001$), but cynicism and professional efficacy were not significantly correlated ($r = 0.05$, $Z = 0.74$, $p = 0.459$). Emotional exhaustion and professional efficacy were positively correlated ($r = 0.22$, $Z = 3.05$, $p = 0.002$).

DISCUSSION

The current study investigated the relation between acute stress symptoms, psychosomatic symptoms, and occupational burnout. It reveals the mechanism of burnout in frontline health professionals battling COVID-19 during the peak time of the outbreak. This study investigated the three different aspects of burnout and the associated mechanism. This study found that

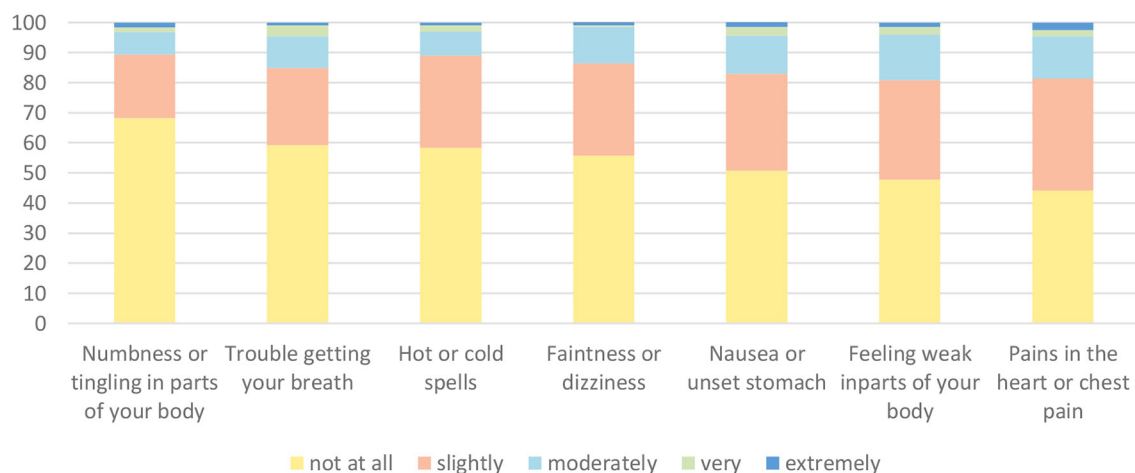


FIGURE 1 | The percentage of specific somatization symptoms.

TABLE 2 | Means and SDs and bivariate correlations of the study variables.

		Descriptive		Correlation			
		M	SD	1	2	3	4
1	Acute stress	67.68	29.34				
2	Somatization	11.56	5.19	0.69***			
3	Emotional exhaustion	15.89	8.21	0.67***	0.58***		
4	Cynicism	9.80	5.75	0.57***	0.54***	0.70***	
5	Professional efficacy	27.30	10.81	0.09	0.09	0.23**	0.10

** $p < 0.005$, *** $p < 0.001$.

TABLE 3 | Means and SDs of MBI subscales in Jinyintan Hospital personnel and in a large international community sample published by Schutte et al. (19).

	Jinyintan Hospital (N = 199)		Schutte et al. (N = 9,055)		Sample Comparison
	Mean	SD	Mean	SD	p-value
Emotional exhaustion	3.18	1.64	1.48	1.41	<0.001
Cynicism	2.45	1.44	1.21	1.53	<0.001
Professional efficacy	4.55	1.80	4.66	1.69	0.449

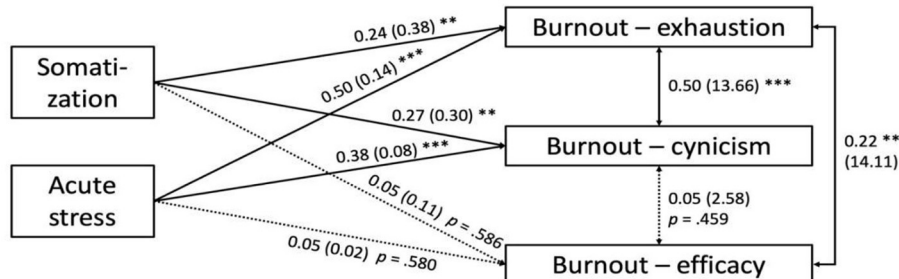


FIGURE 2 | Final SEM with the standardized coefficients followed by the unstandardized coefficients in parentheses. ** $p < 0.005$, *** $p < 0.001$.

the aspects of burnout were significantly positively correlated with each other. The results are meaningful in the assessment of the COVID-19 outbreak experienced by health professionals with the highest stress and who reflected negative occupational experiences. This confirms a focus on the situation of health professionals during the epidemic is urgently needed (24). The proposed model represented the pathways between somatization, acute stress symptoms, and the dimensions of burnout, which provided in-depth understanding of the interaction between those measured variables.

Burnout was conceptualized as emotional exhaustion, depersonalization, negative and cynical feelings toward the occupation, and reduced feelings of accomplishment at work measured by the widely accepted MBI (14, 19). These burnout concepts reflected the physical, emotional, and mental symptoms, in which emotional exhaustion caused people to feel drained, and depersonalization was characterized by a lack of empathy and distorted perception of oneself and others; cynical feelings reflected less identification with the job (14, 19). Comparing the health professionals' results with those of a multinational corporation in Schutte's study, this study showed that Jinyintan health professionals reported significantly greater emotional exhaustion and cynicism than the Schutte study employees (19), however, there was no significant difference between the groups in the professional efficacy dimension. The comparison likely highlighted the difference between frontline health professionals and other occupations. During the COVID-19 pandemic, the burnout of the Jinyintan health professionals showed special characteristics, which focused on severe emotional exhaustion and cynicism. This finding was similar to two other investigations for frontline nurses during the COVID-19 epidemic in Wuhan, which used the MBI (22-item) as measurement and found significant burnout in the emotional exhaustion subscales (25, 26). However, a previous study found that oncology physicians and nurses working on the frontline wards for infected patients had a lower frequency of burnout than those working on the general wards during the COVID-19 epidemic in Wuhan, China (27). It is possible these special characteristics of burnout could be due to the local situation in China, which reflects the indigenous distinguishing features. In order to relieve the burnout, it is essential to target the severe aspects of burnout as a priority. On the other hand, this study revealed that during this extreme situation, health professionals fighting the COVID-19 outbreak suffered severe emotional exhaustion and cynicism, but their professional performance, efficacy, and pride did not diminish under extremely difficult circumstances. It is important to note that before COVID-19, occupational burnout was frequently observed in Chinese health professionals (28–30). Although the burnout incidence was high in the current results, it was not higher than a previous study of Chinese doctors (30). The different prevalence of burnout in health professionals was associated with different measurements, participants' ages, and specific occupations and was also impacted by individual factors (29, 30). It is noticeable that the burnout of health professionals was already common before the pandemic. It was predictable that the COVID-19 pandemic promoted burnout and exacerbated the situation,

pushing health professionals toward a risky situation in which they were overburdened by work. It is urgent to note the risky situations for health professionals and implement strategies for resolving burnout.

A wide range of literature has documented that burnout leads to physical stress and sickness; in this study, physical symptoms were also strongly and significantly associated with all three dimensions of burnout (31). Consistent with previous studies, this study's results demonstrated a significant association between somatization and emotional exhaustion and cynicism. However, it did not identify a significant association between somatization and professional efficacy. In a previous study in which occupational burnout was assessed using the MBI-GS, professional efficacy was negatively correlated with both emotional exhaustion and cynicism (19). In this sample, professional efficacy showed no significant correlation with cynicism, whereas professional efficacy and emotional exhaustion were significantly positively correlated. This could indicate that the greater the emotional exhaustion experienced by health professionals, the greater the professional efficacy and contribution they perceive. This obvious counterintuitive relationship between the variables could suggest that the health professionals unconsciously linked their exhaustion to their achievement at work during this crisis. In order to investigate the directions and the pathways of the variables, follow-up studies are needed.

Health professional burnout has a detrimental impact on patient care. A previous meta-analysis indicated that poor well-being and a high level of burnout in health professionals were associated with poor patient safety (32). In order to provide high-quality patient care, the well-being of the health professionals should be emphasized. Besides impacting patients and the health professionals themselves, burnout is also associated with problems for the employing organizations and the healthcare system as a whole (16). Accordingly, working strategies should be adapted to prevent burnout, such as focusing organizational support on health professionals' specific needs, reducing the uncertainty regarding disease control guidelines, and educating about epidemic outbreak crisis management (5). This study indicated that both psychological stress and physical symptoms play important roles in increasing emotional exhaustion and cynicism toward work. Therefore, support should focus on providing health professionals with physical comfort, targeting pain relief, and more importantly ensuring sufficient rest among staff members. Equally important, support should target alleviating psychological stress, in particular acute stress, in response to the crisis among frontline health professionals.

Follow-up studies are required to identify external sources other than occupational burnout; for example, health professionals may experience emotional exhaustion that is related not only to job-associated aspects but also to interpersonal or aspects of the healthcare system. More importantly, as indicated by a previous study on the severe acute respiratory syndrome outbreak, health professionals who suffered from psychological stress were more likely to have posttraumatic stress symptoms (33). It is necessary to monitor health professionals suffering from severe acute stress symptoms

and burnout in order to provide timely support to prevent posttraumatic stress symptoms.

Several study limitations should be noted. First, the data was collected using a self-reported questionnaire, and the health professionals may not have admitted their burnout, especially in the aspect of decreased professional efficacy. Second, the survey was performed in Jinyintan Hospital, which was under the most demand by patients in Wuhan during the outbreak. The severity of the burnout and stress of these health professionals may not be representative of other hospitals in Wuhan or in China. In addition, health professionals with severe burnout or stress may not have participated in the study owing to sick leave or being unwell. Third, the survey did not cover all the related factors of burnout in health professionals. There are other factors which impact on burnout, such as having children and living with family (34). The researchers did not collect the details on types of work, which could also impact burnout. The history of mental health problems was not measured either. It is possible that frontline health professionals with a previous psychological disorder could be more vulnerable to the influence of COVID-19 stress and present acute stress and occupational burnout symptoms earlier. Future studies covering a variety of factors should be carefully conducted. The researchers recommend using in-depth interviews together with cross-sectional surveys to investigate the various factors influencing burnout. Fourth, this is a convenience sample, which cannot accurately reflect the burnout and acute stress experienced by a health professional from different departments or professions. Due to limited resources, the researchers could not investigate the different professions. It is recommended that future studies look into the impacts of the profession on acute stress and burnout. Finally, because of the cross-sectional nature of the analysis, no causality could be guaranteed from the results even though SEM was used to test the causal model. Longitudinal studies are needed to investigate the causal relationships.

CONCLUSION

The current study discussed severe occupational burnout and revealed the mechanisms contributing to burnout in Wuhan

Jinyintan Hospital frontline health professionals. The findings are meaningful for preparing for future emerging infectious disease outbreaks and also highlighting that support for health professionals is critical for disease control.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Human Ethics Committee of the Second Xiangya Hospital of Central South University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JO and XW designed the study. ZD, YW, and HY performed the data analyses and wrote the draft of this manuscript. AW revised the manuscript. DL, ZD, JO, KP, NW, QZ, XH, and KF contributed to the data collection. All authors contributed to the editing of the manuscript and agreed with the final text.

FUNDING

The study: was supported by the National Natural Science Foundation of China (No. 81974217) and the National Clinical Research Center for Mental Disorders (Second Xiangya Hospital, Central South University). These funders had no role in the study.

ACKNOWLEDGMENTS

We thank all health professionals from Jinyintan Hospital involved in this study.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Edited by:

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 20 July 2020

Accepted: 01 March 2021

Published: 15 April 2021

Citation:

Chen W, Ju Y, Liu B, Huang M,
Yang A, Zhou Y, Wang M, Liao M,
Shu K, Liu J and Zhang Y (2021)
Negative Appraisals of the COVID-19
Social Impact Associated With the
Improvement of Depression and
Anxiety in Patients After COVID-19
Recovery.
Front. Psychiatry 12:585537.
doi: 10.3389/fpsy.2021.585537

Negative Appraisals of the COVID-19 Social Impact Associated With the Improvement of Depression and Anxiety in Patients After COVID-19 Recovery

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Objective: Little is known about the factors affecting the recovery of mental health in COVID-19 patients. The purpose of this study is to look into the change of psychological distress and to explore the role of negative appraisals in the improvement of psychological distress in COVID-19 patients after they recovered from the infection.

Methods: We conducted a longitudinal survey on patients with COVID-19 infection in Changsha. The 9-item Patient Health scale, the 7-item Generalized Anxiety Disorder scale, and a newly developed measure, the COVID-19 Impact Scale (CIS) were applied to assess patients' depression, anxiety, and negative appraisal toward COVID-19 infection during their hospitalization and 1 month post-discharge.

Results: Seventy-two patients were included in the analysis. A significant decrease in anxiety and depression levels was observed after patients were discharged from hospital. Two meaningful factors of the CIS were extracted based on factor analysis, namely "health impact," and "social impact." The change of social impact explained the 12.7 and 10.5% variance in the depression and anxiety symptom improvement, respectively.

Conclusions: Change in negative appraisals, especially the appraisals related to COVID-19 social impact may play a vital role in the relief of psychological distress of infected patients. Therefore, a cognitive and social care perspective might be considered when promoting the mental health recovery and readjustment to society among COVID-19 patients.

Keywords: coronavirus disease 2019, patients, mental health, psychology, depression, anxiety, negative appraisals

INTRODUCTION

Since the end of 2019, coronavirus disease 2019 (COVID-19) has emerged from China and spread rapidly to other countries. As of February 2021, the virus has been transmitted to 213 countries, had more than 100 million confirmed cases, and a death toll of 2.2 million has been reached (1). The highly contagious disease has had significant negative impacts on people's health, both physically and mentally.

Previous studies on viral infectious diseases, such as Severe Acute Respiratory Syndrome (SARS) and Ebola virus disease (EVD), have shown that emerging infectious disease can cause serious psychological distress (i.e., depression and anxiety) in patients during the acute phase of the disease (2–4). Studies also showed that the infection may have long-term effects on the mental health of the survivors (5–7). One study pointed out that 1 year after the outbreak of SARS, a large portion of survivors were still at a high level of stress, with more than 64% of patients developing mental disorders (8). One study investigated neurological and neuropsychiatric complications in patients with COVID-19 and found that 23 of 123 patients showed altered mental health status that fulfilled psychiatric diagnosis (9). Another qualitative study provided evidence that patients with COVID-19 experienced mental distress including anxiety and fear during the early stages of the disease (10). Moreover, a rapid review indicated that COVID-19 infection adversely affects the mental health status in patients (11). These findings suggest that we need to pay attention not only to the physical recovery of the infected patients, but also to the mental recovery of patients in the current COVID-19 epidemic.

Several factors were suggested to play an important role in the mental health status of the infected patients, including the disease condition (12) or being isolated or quarantined during hospitalization (13). However, these short-term influencing factors do not sufficiently explain the continued mental distress in patients after they have recovered from the infection. There are other factors that influence the long-term mental health condition of patients.

Negative appraisals were found to play an important role in the course of mental distress and its prognosis (14–17). A study of collegiate students in China showed that COVID-19-related negative appraisals was positively correlated with their emotional distress (18). A previous SARS study on medical staff reported a high level of post-traumatic symptoms among those who had perceived discrimination or felt rejected (19). In addition, another SARS study revealed a significant correlation between negative appraisals of the disease and symptoms of depression and anxiety (20). These lead us to the hypothesis that negative appraisals of the COVID-19 infection may exert influence on the mental recovery of patients.

In light of the above, we conducted a longitudinal study involving patients with COVID-19 in Changsha. The purpose of this study is as follows: first, to track the change in depression and anxiety levels in patients before and after they have recovered from the COVID-19 infection. Second, to explore the role of negative appraisals in depression and anxiety symptom improvement in patients after COVID-19 recovery.

METHODS

Participants

This study was approved by the ethics review boards of The First Hospital of Changsha. The target population comprised all the COVID-19 patients admitted to The First Hospital of Changsha (Changsha, Hunan, China), which is the only designated hospital in Changsha city to receive patients with COVID-19 for treatment.

We conducted a longitudinal questionnaire survey on all hospitalized patients with COVID-19 from February to April 2020. COVID-19 was diagnosed according to the diagnosis and treatment plan for COVID-2019 released by the National Health Commission (21). Patients who consented to participate and were able to complete the online survey were included in the study. Patients who were below the age of 18, were unable to provide informed consent for any reason, or could not use mobile devices to complete all the questionnaires on their own were excluded from the study.

Study Design

A baseline survey was conducted during patients' hospitalization. The nurse in the isolation ward informed the eligible patients that the online survey was set up to investigate the prevalence and related factors of mental distress in the COVID-19 pandemic. After acquiring the verbal consent of the participants, the nurse provided the patients with the website to fill out the questionnaire. The patients signed the electronic informed consent on the homepage of the website before the survey. At the end of the questionnaire, participants were asked about their needs for mental health services.

A follow-up survey was conducted 1 month after the patients were discharged from the hospital. The researchers contacted the patients by phone to learn about their current physical and mental health status. After obtaining verbal consent, the researchers sent patients a website link of the follow-up survey. Participants were asked to sign the electronic informed consent before they completed the questionnaire. Furthermore, mental health services were provided according to their self-reported mental health service needs after the follow-up survey, and patients who met the cut-off points (10 points) for PHQ-9 or GAD-7 were suggested for further individual evaluation and psychological counseling.

Study Measures

The patients who agreed to participate in the study were asked to fill out a questionnaire recording their demographic information, clinical characteristics, and psychological variables. The demographics included age, gender, marital status, and years of education. The clinical characteristics comprised past medical history, duration of hospitalization, and the severity of COVID-19. The Chinese version of the 9-item Patient Health Questionnaire (PHQ-9; range, 0–27) and the 7-item Generalized Anxiety Disorder scale (GAD-7; range, 0–21) were used to assess the severity of the patients' depression and anxiety symptoms. The Chinese version of PHQ-9 and GAD-7 showed good reliability and validity in general hospital inpatients (22, 23). The

COVID-19 disease-related questionnaire was used to reflect the degree of the patients' negative attitudes toward the infection. This 9-item scale was referred to the self-compiled questionnaire of the SARS Impact Scale (20). These nine items assessed the most common negative appraisals during and after the acute phase of coronavirus infection. A Likert scale was used to compile the scale and each question had five options with a score of 1–5 (1 = "not worried at all" and 5 = "extremely worried"). We named the revised self-rating scale COVID-19 Impact Scale (CIS). Moreover, we calculated the change scores of PHQ-9 /GAD-7/CIS by subtracting the baseline scores from the follow-up scores to indicate the improvement of mental distress or the change of negative appraisals. Other variables included patients' isolation sites during the first 2 weeks after getting discharged (categorized as at home or at the designated hotel) and mental health service utilization throughout the follow-up period (categorized as received or not received online or telephone supportive counseling).

Statistical Analysis

All analyses were conducted in SPSS Version 25.0. The significance evaluation was set at $P < 0.05$ (two-tailed). For continuous variables, a Kolmogorov-Smirnov test was carried out to test for normality of the distribution. Data with normal distribution were presented as mean and standard deviation, and an independent sample *t*-test was used to compare the differences between the patients included and excluded. Data that were non-normally distributed were presented as median and quartile distance, and a Mann-Whitney *U* test was used for comparison of the two groups. Categorical variables were presented as frequency and percentages in each category, and a Pearson's chi-squared test was used to detect differences between the included and excluded patients as well.

Exploratory factor analysis using principal component analysis (PCA) and Varimax rotation was conducted to explore the underlying structure of CIS as well as summarize the variables of CIS. The appropriateness of factor analysis was assessed with the Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) measure. The minimum factor loading cut-off point was set at 0.4 and factors with eigenvalues > 1 were selected. The internal consistency of each factor was assessed by Cronbach's α . Items were combined if Cronbach's α reached 0.80.

Repeated measure of the General Linear Model (GLM) was used to examine the effect of time on depression and anxiety as well as on patients' negative attitudes toward the infection. Demographics (age, gender, education, marriage), clinical characteristics (past medical history, severity of COVID-19, and duration of hospitalization), and supportive counseling during isolation (received or not) were included in the GLM as covariates, but were finally removed from the model as none of them showed significant effect.

Pearson correlation analysis was applied to explore the variables (i.e., demographic variable, clinical variable, and negative appraisals) that were associated with depression and anxiety symptom improvement (baseline scores—follow-up scores). Linear regression analyses were used to examine variables that explained the variance of patients' depression and anxiety

symptom improvement. Variables significantly correlated with depression and anxiety symptom improvement were used as independent variables in the linear regression analysis, and depression and anxiety symptom improvement served as dependent variables, respectively.

RESULTS

Participants

A total of 251 patients with COVID-19 were admitted to the hospital during the peak stage of COVID-19 in China. By February 9, 39 patients had recovered and been discharged from hospital. Besides, six subjects under 14 years old were excluded from our study. Questionnaires were sent to 206 patients in hospitalization and 163 patients gave their consent to take part in the study at baseline. The overall response rate at baseline was 79.13%. During follow-up, 18 patients dropped out because of incorrect phone numbers or missed calls. Among 145 potential participants who answered the calls, 39 subjects did not consent to participate in the follow-up survey at the time of informed consent. The remaining 114 replies represented a response rate of 78.6%.

There were 42 patients who had not fully completed the Coronavirus Impact Scale (CIS) during baseline or the follow-up time point. Eventually, 72 patients who filled in the CIS in both time points were included in the analysis. **Table 1** shows the demographic and clinical characteristics of the patients. The median age was 38 years (IQR, 29–47) among the included patients. Gender was closely balanced between men and women with 37 male patients (57.1%). Twenty-three patients (31.9%) had a history of physical disease and three patients (4.2%) had a history of mental disorder. The average length of stay was 17.7 days. There were no significant differences between included and excluded (the participants dropped out or with incomplete data) patients in the demographics, clinical characteristics, and psychological dimension.

Psychological Distress in Patients

Depression and anxiety scores during baseline and follow-up are shown in **Table 2**. The median scores of PHQ-9 and GAD-7 at baseline were 4 (IQR, 2–7), and 5 (IQR, 0–7), respectively. A total of 42.3% of the patients reported at least mild depression and 50.7% of patients reported anxiety symptoms. One month after discharge, the scores of both scales decreased (PHQ: 3, IQR 0–7; GAD: 3, IQR 0–7). GLM analysis revealed a significant effect of time on depression levels ($F = 5.593$, $P = 0.021$; **Figure 1**) and anxiety levels ($F = 6.387$, $P = 0.014$; **Figure 1**).

Negative Appraisals in Patients

The Bartlett's test of spherical ($\chi^2 = 371.98$, $df = 36$, $P < 0.001$) and KMO measure (KMO = 0.845) showed that the CIS was suitable for factor analysis. The internal consistency of the total score was 0.932. PCA analysis yielded two factors, explaining 69.84% of the variance of CIS data. The two factors were named as health impact and social impact, respectively (**Table 3**). Both factors showed good internal consistency; Cronbach's alpha reached 0.896 for health impact and 0.885 for social impact.

TABLE 1 | Demographics and clinical characteristics of patients.

Demographics and clinical characteristics	Patients at baseline (<i>n</i> = 163)	Patients included (<i>n</i> = 72)	Patients excluded (<i>n</i> = 91)	<i>t</i>	<i>P</i>
Age, median (IQR)	40 (31–50)	38 (29–47)	41 (31–50)	0.178	0.859 ^a
Gender, <i>n</i> (%)				0.275	0.600 ^b
Males	80 (49.1)	37 (51.4)	43 (47.3)		
Female	83 (50.9)	35 (48.6)	48 (52.7)		
Marriage, <i>n</i> (%)				0.082	0.775 ^b
Unmarried or divorced	39 (23.9)	18 (25.0)	21 (23.1)		
Married	124 (76.1)	54 (75.0)	70 (76.9)		
Education, <i>n</i> (%)				1.312	0.252 ^b
High school and below	60 (36.8)	23 (31.9)	37 (40.7)		
Undergraduate	86 (52.8)	40 (55.6)	46 (50.5)		
Postgraduate and above	17 (10.4)	9 (12.5)	8 (8.8)		
History of physical disease, <i>n</i> (%)	25 (15.3)	23 (31.9)	22 (24.2)	0.972	0.332 ^b
History of mental disorder, <i>n</i> (%)	6 (3.7)	3 (4.2)	3 (3.3)	−0.663	0.509 ^b
Duration of hospitalization, mean ± SD	18.2 ± 8.3	17.7 ± 8.6	18.5 ± 8.0	0.629	0.530 ^c
Severity of COVID-19, <i>n</i> (%)				0.058	0.810 ^b
Severe	19 (11.7)	9 (12.5)	10 (10.9)		
Mild	144 (88.3)	63 (87.5)	81 (89.1)		
Isolation site				N/A	N/A
Home	N/A	33 (45.8)	N/A		
Designated hotel	N/A	39 (54.2)	N/A		
Mental health service utilization, <i>n</i> (%)				N/A	N/A
Received	N/A	34 (47.2)	N/A		
Not received	N/A	38 (52.7)	N/A		
PHQ-9, mean ± SD	5.25 ± 5.53	5.70 ± 5.52	4.90 ± 5.55	−0.917	0.360 ^c
Median, range	4 (1–7)	4 (2–7)	3 (1–6)		
GAD-7, mean ± SD	4.85 ± 5.25	5.59 ± 5.70	4.28 ± 4.83	−1.587	0.115 ^c
Median, range	4 (0–7)	5 (0–7)	3 (0–7)		

n, number of participants; IQR, interquartile range; N/A, not available; SD, standard deviation.

^a*P*-values obtained by Mann–Whitney *U* test; ^b*P*-values obtained by Pearson's chi-square test; ^c*P*-values obtained by student *t* test.

TABLE 2 | Depression and anxiety in COVID-19 patients.

	Baseline	Follow-up
PHQ-9		
Mean, SD	5.70 ± 5.52	4.43 ± 5.19
Median, range	4 (2–7)	3 (0–7)
GAD-7		
Mean, SD	5.59 ± 5.70	4.11 ± 4.26
Median, range	5 (0–7)	3 (0–7)

PHQ-9, 9-item Patient Health Questionnaire; GAD-7, 7-item Generalized Anxiety Disorder scale; *n*, number of participants; SD, standard deviation.

Therefore, the subsequent analysis will use the total scores of the two dimensions.

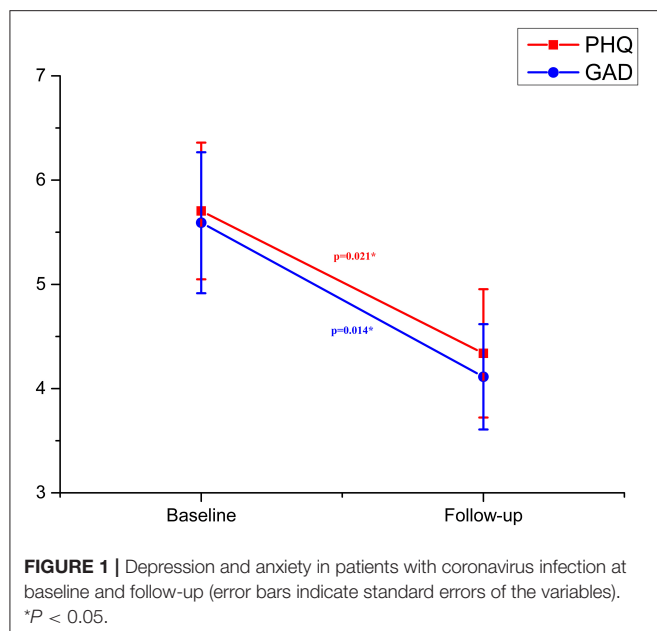
No significant effect of time was detected by the GLM analysis on the total scores of the CIS ($F = 3.75$, $P = 0.057$; **Figure 2**). However, a significant effect of time on the health impact scores was observed ($F = 11.94$, $P < 0.001$; **Figure 2**). Particularly, the health impact scores decreased over time. Besides, there was no

significant effect of time on the social impact scores ($F = 1.29$, $P = 0.259$; **Figure 2**).

Relationship Between the Change of Negative Appraisals and Symptom Improvement in Depression and Anxiety

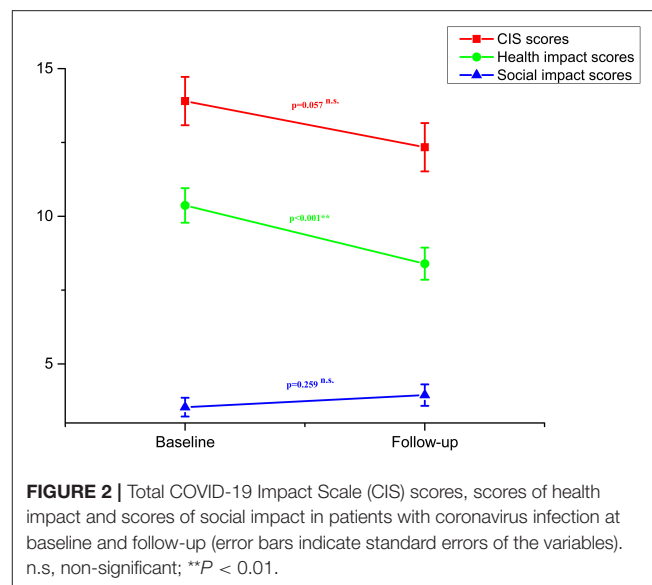
To explore the variables associated with the depression and anxiety symptom improvement, correlation analyses were conducted. Pearson correlation analysis showed that the patients' demographic data, clinical characteristics, or negative appraisals (total score or factor score) had no significant correlation with the improvement in PHQ-9 scores and GAD-7 scores. However, the change of social impact was significantly correlated with the improvement in PHQ-9 scores and GAD-7 scores (PHQ: $t = 0.440$, $P < 0.001$; GAD: $t = 0.251$, $P = 0.038$). The change of health impact was significantly correlated with the improvement in PHQ-9 scores ($t = 0.29$, $P = 0.017$), but not with the improvement in GAD-7 scores (**Table 4**).

Based on the above results, we included variables that were significantly associated with the improvement of depression and anxiety scores in the linear regression analysis. Results showed

**TABLE 3 |** Results of the exploratory factor analysis of CIS.

Patients with COVID-19		
Kaiser-Meyer-Olkin measure	0.845	
Bartlett's test	Chi-square = 371.977, $P < 0.000$	
Component	Healthy impact	Social impact
Eigenvalue	5.13	1.16
Percentage of variance	57.00	12.84
Rotated component matrix, items (loading)	1. The medicine will have side effects on me (such as memory loss, etc.). (0.75) 2. I'm worried about passing the virus on to my family. (0.79) 3. COVID-19 will permanently damage my health. (0.83) 4. Even if I recover, I could be re-infected. (0.77) 5. I will have a mental problem. (0.63) 6. I will become a virus carrier. (0.76)	7. I will lose my job/have financial problems in the future. (0.84) 8. People will discriminate against me because I had COVID-19. (0.77) 9. My family will be destroyed by COVID-19. (0.87)

that the change of social impact could explain the 12.7% variance of the PHQ-9 improvement and the 10.5% variance of the GAD-7 improvement (PHQ-9: $R^2 = 0.127$, $t = 2.691$, $P = 0.009$; GAD-7: $R^2 = 0.105$, $t = 2.547$, $P = 0.013$). Health impact could not explain the variance of improvement in PHQ-9 or GAD-7 (Table 5).

**TABLE 4 |** Association between the change of negative appraisals and patients' depression and anxiety symptom improvement.

	Change of PHQ-9	Change of GAD-7	Change of health impact	Change of social impact
Change of PHQ-9	-			
Change of GAD-7	0.714**	-		
Change of health impact	0.285*	0.097	-	
Change of social impact	0.440**	0.251*	0.466**	-

PHQ-9, 9-item Patient Health Questionnaire; GAD-7, 7-item Generalized Anxiety Disorder scale; ** $P < 0.01$; * $P < 0.05$.

TABLE 5 | Results of linear regression analyses on patients' depression and anxiety symptom improvement.

Variables	b	SE	β	t	P	R^2
Change of PHQ-9						
Change of social impact	0.560	0.208	0.348	2.691	0.009**	0.127
Change of health impact	0.018	0.131	0.018	0.136	0.892	
Change of GAD-7						
Change of social impact	0.529	0.208	0.334	2.547	0.013*	0.105

b, unstandardized coefficients; β , standardized coefficients; ** $p < 0.01$; * $p < 0.05$.

DISCUSSION

This study explored the mental health recovery and its relationship with negative appraisals in patients who had recovered from COVID-19. We found that 1 month after discharge, patients' depression and anxiety symptoms were significantly improved. The change of the negative appraisals of COVID-19 social impact, rather than the health impact, could explain the depression and anxiety symptom improvement.

Previous studies have shown that patients infected with a novel virus also suffered from mental health problems (24–26). Recently, many studies also revealed that people associated with COVID-19 have suffered varying degrees of psychological distress (9–11, 27–30). However, most of these were cross-sectionally designed and failed to explore the changing process and influencing factors of patients' mental health status. In our study, we found that nearly half of patients with COVID-19 exhibited depression and anxiety symptoms. Although a significant decrease in both depression and anxiety levels was observed, about a third of patients who had recovered from COVID-19 still had obvious psychological distress 1 month after discharge. The improvement in depression and anxiety symptoms was related to the change in the negative appraisals of COVID-19 social impact. The social impact items in the CIS questionnaire (i.e., financial stress, stigma, and concerns about family) did not diminish with the recovery of the disease, yet it explained the change in depression and anxiety levels. Previous studies have shown that greater negative attitudes will lead to a more protracted depressive episode (31, 32). Persistent negative appraisals might lead to long-term depression, while negative emotions may enhance patients' negative appraisals, which is a negative thinking cycle (33). Besides, social support was a main protective factor of maintaining mental wellbeing. However, negative appraisal including fear of infection, feeling of uncertainty, and stigmatization were risk factors for self-isolation which often leads to deprivation of social support (34). Therefore, the negative appraisals, especially those related to COVID-19 social impact, may be one of the sources that perpetuates psychological stress in patients after physical recovery.

It is interesting that the change of negative appraisals related to COVID-19 social impact was more related to symptom improvement in depression and anxiety than the change in negative appraisals of COVID-19 health impact. Several factors might contribute to this phenomenon. On the one hand, COVID-19 had a much lower case fatality rate than that of SARS or Ebola, and most of the patients with COVID-19 presented with mild symptoms. Therefore, the negative appraisals related to COVID-19 health impact might have a limited contribution to depression and anxiety. And the decrease in negative appraisals of COVID-19 health impact was not very closely related to depression and anxiety symptom improvement. On the other hand, COVID-19 is a highly contagious infectious disease and triggers an unprecedented level of panic among the public (35). Patients who recovered from COVID-19 are facing substantial stigma and discrimination when they come back home (36). Although patients have recovered from the infection and finished quarantine for medical observation, they are suffering from social isolation and economic problems or unemployment because of the diagnosis (37). Consistently, a recent study also reported that COVID-19-related financial and social difficulties or concerns were a major risk factor for psychological distress in subjects (38). Therefore, disturbing social problems may be more strongly linked to psychological distress in patients. And the change of negative appraisals related to COVID-19 social impact might contribute to the variation in depression and

anxiety. In order to alleviate the depression and anxiety in recovered patients, we could address COVID-19-related social issues. For example, during patients' hospitalization, mental health professionals should be integrated into the medical treatment team to provide targeted psychological interventions. In addition, continued mental health interventions should be prepared for those affected patients after they have been discharged from the designated hospital. These approaches could help to reduce patients' maladaptive beliefs and help to minimize their psychological distress. Except for specific interventions aimed at patients, some effort could be done among the general public and government. For example, health education for the general public could help to reduce the stigma attached to COVID-19. Broadcasting precise and authoritative information such as the fact that recovered patients do not pass the virus to others will help to decrease the discrimination among society (39). In addition, the government could provide unemployment insurance to mitigate the economic impact of COVID-19.

Our study has the following strengths: first, we longitudinally investigated the change in mental distress of patients infected with COVID-19. In addition, we found that the social dimensions played an important role in the mental health of patients during the pandemic. Furthermore, we suggested that more attention should be given to the negative impact of the social dimension on patients' mental health. There are nevertheless several limitations in this study. Firstly, the small sample size and single-site study design limits the ability to generalize the results of the current study. Secondly, online self-reporting was used in the survey, which may bring selection bias since those who cannot use mobile devices were excluded from our study. Thirdly, we recruited 163 participants in the baseline but only 72 participants had complete data at both time points, the response rate was unsatisfactory. However, this may not bring significant bias to the results since we did not detect significant difference in baseline characteristics between the patients with complete data and those excluded. Furthermore, a causal relationship between the change of negative appraisal in COVID-19 social impact and depression or anxiety symptom improvement cannot be drawn from the current study. Long-term change in patients' mental status should be monitored and how the change in negative appraisals influence the future psychological distress should be explored. Finally, using only negative appraisals as a risk factor for the psychological distress in patients was inadequate. Future studies could investigate other influencing factors for patients' mental health during the pandemic.

CONCLUSION

Patients who had recovered from COVID-19 showed significant improvement in depression and anxiety symptoms. The change of negative appraisals in the COVID-19 social impact might play a major role in reducing their depression and anxiety. Strategies targeting the reduction of COVID-19-related social issues might be helpful to improve the mental health of recovered patients during the COVID-19 crisis.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the ethics review boards of The First Hospital of Changsha. The patients/participants provided their electronic informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors had full access to all the data in the study and had full responsibility for the content of the manuscript for publication. KS, JL, and YZha was responsibility for the final review and had final responsibility for the decision to submit for publication.

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FUNDING

This work was supported by the Project of Hunan Provincial Department of Science and Technology (2020SK3014 to JL), the Defense Innovative Special Region Program (17-163-12-ZT-001-041-01 to YZha), the National Natural Science Foundation of China (81671353 to YZha), the National Key Research and Development Program of China (2019YFA0706200 to YZha), and Changsha Science and Technology Bureau (KQ2001005 to KS). The authors gratefully acknowledge financial support from the above affiliations.

ACKNOWLEDGMENTS

The authors would like to thank all the health care workers and patients who fighting against the COVID-19. YJ was supported by postdoctoral programme in Central South University.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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What's Happened to Italian Adolescents During the COVID-19 Pandemic? A Preliminary Study on Symptoms, Problematic Social Media Usage, and Attachment: Relationships and Differences With Pre-pandemic Peers

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OPEN ACCESS

Edited by:

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King's College London,
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Reviewed by:

Federica Sancassiani,
University of Cagliari, Italy
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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 01 August 2020

Accepted: 29 March 2021

Published: 27 April 2021

Citation:

Muzi S, Sansò A and Pace CS (2021)
What's Happened to Italian
Adolescents During the COVID-19
Pandemic? A Preliminary Study on
Symptoms, Problematic Social Media
Usage, and Attachment: Relationships
and Differences With Pre-pandemic
Peers. *Front. Psychiatry* 12:590543.
doi: 10.3389/fpsy.2021.590543

Italian adolescents were confined at home for 3 months due to the COVID-19 pandemic, which exposed them to feelings of fear, uncertainty, and loneliness that may have increased their vulnerability to emotional-behavioral symptoms (e.g., anxiety) and binge-eating attitudes. Potential risk factors for these psychopathological symptoms are problematic social media usage and attachment insecurity. Therefore, this study aimed: (1) to assess emotional-behavioral symptoms, binge eating, problematic social media usage, and attachment representations of adolescents during the pandemic, comparing them with prepandemic similar samples; (2) to investigate relationships among variables, exploring the role of problematic social media usage and insecure attachment as risk factors for more psychopathological symptoms. *Participants* were 62 community adolescents aged 12–17 years, enrolled through schools, and assessed online through the following *measures*: Youth Self-Report for emotional-behavioral problems, Binge-Eating Scale for binge eating, Social Media Disorder Scale for problematic social media usage, and the Friends and Family Interview for attachment. The main *results* were: (1) 9.4% of adolescents showed clinical rates of emotional-behavioral symptoms and 4.8% of binge eating attitudes. The comparison with pre-pandemic samples revealed that pandemic teenagers showed lower internalizing, but higher other problems (e.g., binge drinking, self-destructive behaviors) and more problematic social media usage than pre-pandemic peers. No differences in binge-eating attitudes and attachment were revealed (76% secure classifications). (2) Problematic social media usage was related to more binge eating and emotional-behavioral problems, predicting 5.4% of both delinquent and attention problems. Attachment disorganization predicted 16.5% of internalizing problems, somatic complaints, and social and identity-related problems. In *conclusion*, confinement did not increase adolescents' internalizing symptoms -i.e., vulnerability to mood disorders of an anxious-depressive type- which even decreased.

However, teenagers may have expressed their discomfort through other problems and symptoms of social media disorder. Further studies should explore the role of adolescents' problematic social media usage and attachment insecurity as risk factors for additional psychopathological symptoms.

Keywords: COVID, pandemic (COVID-19), adolescents, emotional-behavioral symptoms, Binge-Eating disorder, attachment representations, risk assessment, social media disorder scale

INTRODUCTION

Since December 2019, the new form of coronavirus named SARS-CoV-2 has quickly spread worldwide, and one of the most affected countries was Italy, registering more than 2.85 million cases and over 96,000 deaths from late January 2020 to February 2021.

As a consequence of the growing number of cases that the health system was struggling to support, from February 2020, Italy activated legislative lockdown measures in affected regions, such as closing schools and commercial activities, travel restrictions or prohibitions, and quarantine for locals. Since March 11, when the World Health Organization (WHO) declared SARS-CoV-2 a pandemic emergency (i.e., COVID-19 pandemic), the Italian government extended the restrictions to the whole country, and all Italians were confined to their homes up to mid-May.

The exposure to this abnormal pandemic event may have negatively influenced the social, physical, and psychological functioning of children and adolescents in different ways, due to prolonged exposure to feelings of fear and uncertainty (e.g., loss of some relatives), and to physical and social isolation due to confinement (1, 2).

Indeed, international studies report that teenagers showed an increase in *emotional-behavioral symptoms* during the pandemic, especially of anxiety, depression, post-traumatic stress, and attentional problems (1, 3–9). Moreover, increased anxiety, distress, and sense of loneliness, together with the limited chance to move and buy daily fresh food, may have had adverse effects on adolescent eating behaviors, predisposing them to rely upon food as a source of comfort and an emotional regulator, which could increase their risk to engage in *binge eating attitudes* (10, 11).

By contrast, in the Co-SPACE study (12), parents reported a decrease in emotional difficulties in their teenagers, who did not recognize changes in their emotional-behavioral symptoms. Furthermore, Italian adolescents showed moderate anxiety, less than peers in other Mediterranean countries, and more healthy dietary habits during confinement (13–15).

Therefore, especially in Italian teenagers, there is a clear need for more data to define the extent of adolescents' emotional-behavioral symptoms and binge eating attitudes during this anomalous situation, together with more information on the effects of established risk or resilience factors for them.

During the lockdown, there was a dramatic increase in using social media, namely social networking sites (e.g., Facebook, Instagram, TikTok), messenger platforms (e.g., Whatsapp, Skype), and online video games that adolescents used to

communicate with relatives and friends or for entertainment (16, 17). Along with concern about the pandemic, this increase was associated with adolescents' compulsive internet use, indicative of a deeper *problematic social media usage* (18). The assessment of the problematic use of social media in adolescents is relevant in preventive and clinical terms, because it can be a prodromal indicator or aggravate toward the development of a Social Media Disorder, characterized by symptoms of compulsion, tolerance, salience, and withdrawal applied to social media (19). Moreover, individuals manifesting problematic social media usage may also show desire for constant connectivity and a preference for online social interaction that lead to distress and impairments in the social and emotional functioning of the user (20–25). Moreover, pre-pandemic reviews and meta-analyses have established problematic social media usage as a risk factor for more anxious-depressive symptoms and disordered eating behaviors of adolescents (22, 26, 27). During the confinement, social media was a potential source of inaccurate or misleading health news regarding COVID-19, further predisposing users to panic distress and anxious-depressive symptoms (28–31). In addition, teenagers who used more social media during the pandemic reported more anxiety, depression, and other problems, such as self-destructive symptoms (32, 33).

On the other side, some studies suggest social media usage as helpful, rather than problematic, to cope with potential feelings of anxiety and loneliness due to the temporary restriction of face-to-face contacts at school and with friends (34–37). Therefore, there is no agreement on the risk or buffering effect of social media usage on adolescents' symptoms during the pandemic.

Another factor deserving attention is *attachment*, in terms of attachment Internal Working Models [IWMs; (38, 39)], i.e., mental representations of self, significant other, and relationships between self and significant other, stemming from early interactions with primary caregivers and generalized to become a template to further relationships. According to Bowlby (39), IWMs tend to stability across life events, influencing the social adjustment and the psychopathological vulnerability of the individual. Indeed, Rajkumar (40) employs attachment theory to understand individuals' responses and mental health outcomes during the COVID-19 pandemic, and Steele (41) specifically suggested that attachment security moderated the experience of fear during the pandemic, predisposing to more positive reactions.

By definition, a securely-attached person appears flexible and balanced in seeking closeness and separation within significant attachment relationships, valuing them as something useful and rewarding. *Securely-attached* individuals openly discuss personal

attachment experiences and related emotions even if they were harsh and painful, and they typically show a desire to connect with others, which helps their lifelong social adaptation (39, 42, 43). During adolescence, securely-attached teenagers usually show better social skills, self-esteem, and adaptive stance in stressful situations, as they are more prone to seek comfort and help from parents and friends (44–46).

By comparison, *insecurely-attached* individuals usually show difficulties in relationships due to attachment strategies that prompt imbalances toward the search for excessive separation, i.e., insecure-dismissing, or unwarranted closeness, i.e., attachment preoccupation (42, 45). On the one hand, individuals classified as *insecure-dismissing* appear unbalanced toward exploration; they tend not to seek attachment figures for help or comfort, preferring to rely on themselves and portraying themselves as strong, normal, and independent. Insecure-dismissing individuals recount their attachment experiences untruthfully, showing idealization or derogation of the attachment figures and the tendency to normalize the negative experiences (42). Overall, they show an affective hypo-activation in response to emotions and stimuli from significant relationships and excessive attention to the relationships' instrumental and concrete aspects.

On the other hand, individuals classified as *insecure-preoccupied* prefer proximity to the detriment of exploration, showing anxious hypervigilance toward attachment figures and signals coming from attachment relationships. Such hyper-evaluation of attachment relationships may lead to an excessive response of anger or passivity toward parents or an age-inappropriate desire to please or substitute them, i.e., role-reversal. Both types of insecure patterns predispose an individual to low adaptive responses to stressors, especially if coming from attachment relationships since when insecurely-attached individuals are troubled or need help, they find it more challenging to seek comfort or help from others and to regulate their negative emotions (45, 47, 48).

Lastly, individuals classified as disorganized simultaneously manifest contradictory attachment strategies (e.g., dismissing and preoccupied) or no strategy structuring individual's relational behavior and expectations on the others' one, often because of previous unresolved frightening and traumatic relational experiences (42).

Pre-pandemic literature highlighted that teenagers showing insecure and disorganized attachment IWMs are more at risk for both emotional-behavioral symptoms and binge-eating attitudes, and they also engage a more problematic social media usage, potentially increasing its negative effect on teenagers' symptoms (49–54).

During the pandemic, a single study on attachment was published demonstrating Italian adults who showed the worst mental health outcomes with an insecure-preoccupied pattern, while securely-attached adults showed better mental health (55).

Given the above, securely-attached teenagers may have been more resilient in facing a fearful situation (such as the COVID-19 pandemic and consequent restrictions), thanks to their secure IWMs, which enabled them to be more capable of

managing feelings of fear and anxiety or maintaining positive interactions with friends despite the unusual online form. However, no published studies explored teenagers' attachment during the pandemic.

Furthermore, no research simultaneously explored the role of teenagers' problematic social media usage and attachment IWMs on their symptoms during the lockdown due to the COVID-19 pandemic. Therefore, the current study had two *aims*:

- (a) To assess emotional-behavioral and binge eating symptoms, problematic social media usage (i.e., social media disorder symptoms), and attachment insecurity in community adolescents during the pandemic, comparing assessments of community adolescents before the pandemic (from similar groups). Higher symptoms in pandemic participants than pre-pandemic groups were hypothesized, except for attachment, where no difference was hypothesized.
- (b) To examine the relations among emotional-behavioral symptoms and binge-eating attitudes with problematic social media usage and attachment IWMs of community adolescents during the pandemic. More emotional-behavioral symptoms and binge-eating attitudes in teenagers with more problematic social media usage and/or higher attachment insecurity/disorganization were hypothesized.

MATERIALS AND METHODS

Participants and Procedure

Sixty-two community adolescents aged 12–17 years [Mean (M) = 15.43, Standard Deviation (SD) = 1.65, 37% boys] were enrolled from late March to early May 2020, through schools from Northern Italy for more extensive longitudinal research. Participants were included in the current pilot comparative study if they: 1. were between 12 and 17 years of age; 2. had no diagnosis for severe psychiatric disorders or intellectual or physical disability; 3. have been assessed during the lockdown, between April and May 2020.

All participants eligible for this study accepted to participate (0% attrition), and the majority of them attended high school (73%, $n = 43$), while 30% of them ($n = 19$) attended middle schools. Most of them came from intact families (82%) and had at least one sibling (55%) or more (18.4%). The mean age of adolescents' mothers was 48.70 years (SD = 4.70), while the mean age of adolescents' fathers was 51.20 (SD = 6.16), and almost all parents achieved high school diplomas or higher levels of education and had a job (99%).

Pre-pandemic groups for the comparison were drawn by Marino et al. (23), Pace and Muzi (10), and Pace et al. (56) because the community adolescents from these studies were similar to participants, but their assessments were carried out before the pandemic (between 2019 and January 2020). Indeed, adolescents in these studies lived in Northern Italy and in low-risk intact families, similarly than participants. The group from Pace and Muzi [(10); $N = 382$, age-range 13–18 years, $M = 15.59$, $SD = 1.10$, 39% boys] came from the same region and similar social-familiar background than the current one, showing no differences in age, $t(442) = 0.98$, $p = 0.320$ (95% CI 0.48–0.16), or gender

distribution, a $\chi^2(1) = 0.08$, $p = 0.770$, $\phi = 0.02$ (95% CI 0.61–1.92). This group was compared on prevalence and scores for *binge eating attitudes* and for *emotional-behavioral symptoms* (using unpublished data) because the Italian validation study (57) did not report the prevalence and mean scores of the normative Italian sample in the Youth Self Report [YSR; (58)] here used. The group from Pace et al. (56); $N = 110$, age-range 11–17 years, $M = 14.22$, $SD = 1.84$, 50% boys) also came from the same region and had similar social-familiar backgrounds of participants, showing no difference in gender distribution, $\chi^2(1) = 2.54$, $p = 0.120$, $\phi = -0.11$ (95% CI 0.36–1.12), but they were younger than participants, $t(170) = 4.29$, $p = 0.001$ (95% CI 0.65–1.77). Given this study employed the Friends and Family Interview [FFI; (45)], this pre-pandemic group was selected because this was the largest group of Italian community teenagers assessed with the same instrument. Lastly, the group from Marino et al. [(23); $N = 761$, age-range 13–19 years, $M = 15.49$, $SD = 1.03$; 56.5% boys] came from the Northern area of the country, showing no difference in age with participants, $t(821) = 0.41$, $p = 0.610$ (95% CI -0.34 to 0.22), while the gender distribution differs due to more girls in the current study, a $\chi^2(1) = 6.14$, $p = 0.013$, $\phi = -0.18$ (95% CI 0.28–0.86). This group was selected for the comparison on social media usage scores because it is the only pre-pandemic group of Italian teenagers assessed with the questionnaire used in this study, the Social Media Disorder Scale [SMDS; (19)].

The research received approval (protocol n. 037) from the University Ethical Committee of the Department of Educational Sciences of the University of Genoa in Italy, which approved research procedure and purposes, as in line with the international research's broader ethical criteria community (Declaration of Helsinki). During online class hours, the research team informed potential participants and their families about the research aims and procedures, reminding them that participation was voluntary and explaining the rights in the informed consent sheet (privacy, withdrawal from the research without motivating the choice, etc.). After that, all legal caretakers of adolescents who agreed to participate signed an informed consent *via* an electronic signature. Thus, participants filled online questionnaires *via* Lime-survey software and trained M.A. students in psychology interviewed them through taped video calls *via* Skype in compliance with social distancing rules during the pandemic. Participants filled all questionnaires on an online form accessible through a personal secret code, which the research group used to trace the questionnaire-participant combination.

Given the preliminary nature of this study, data of FFI attachment interviews were available for 29 participants (47%), since the coding of the remaining 33 was in progress at the time of this submission. The subgroup of participants with FFI ($n = 29$, $M_{age} = 14.80$, $SD = 1.80$, 40% boys) did not significantly differ from the entire sample in age, gender distribution, family structure, or number of siblings, all $p > 0.05$.

Measures

The Youth Self-Report 11–18 [YSR; (57, 58)] is a 112-item self-report questionnaire to measure emotional-behavioral symptoms in children and adolescents aged 11–18 years old.

The adolescent rates his/her symptoms in the previous 6 months on a three-point Likert-type scale (0 = not true, 1 = sometimes true, 2 = often true). Scores are assigned to several syndromes grouped in the scales: internalizing problems (includes withdrawal/depression, anxiety, somatic complaints), externalizing problems (includes aggressive behaviors and delinquency), other problems (includes social problems such as binge drinking, attention problems, thought problems such as suicidality or dissociative symptoms, and identity problems, such as gender-related and self-destructive problems). There is also a global score on the scale of the total problems. The YSR showed good internal validity (Cronbach's α : 0.71–0.95) and good test-retest reliability ($r = 0.68$). In this study, Cronbach's α was 0.93.

The *Binge Eating Scale* [BES; (59, 60)] is a widely known 16-item self-report questionnaire specifically designed to evaluate the presence and frequency of binge-eating symptoms. There are three or four statements for each item, and the person indicates which statement reflects more his/her condition (e.g., item 1 has “I worry about my appearance, but that doesn't normally make me dissatisfied with myself” as B alternative). Each statement corresponds to a score from 0 to 3, sometimes with two options scoring three points in the same item, e.g., items 3 and 7. The final score range from 0 to 46, and higher scores indicate more severe binge-eating attitudes. Three thresholds constitute cut-off scores: < 17 no risk of binge eating, > 17 moderate binge eating; > 27 clinical risk of binge eating, a Binge Eating Disorder diagnosis is warranted. The BES shows good reliability (Cronbach's $\alpha = 0.87$), and Cronbach's α was 0.81 in this study.

The *Social Media Disorder Scale – 9 items* [SMDS; (19); Italian version (23)] is a short version of an extended 27-item version to capture the problematic usage of social media (Whatsapp, Facebook, etc.) during the past year. The person provides yes/no answers to different questions (e.g., “In the last year, did you realize you were sick when you couldn't use social media?”), which cover nine problematic criteria: persistence, escape, conflict, displacement, deception, withdrawal, preoccupation, tolerance, and problems. In the version used in this study, the SMDS showed acceptable reliability (Cronbach's $\alpha = 0.76$), and the same value (0.76) was found in this study.

The Friends and Family Interview - COVID-19 version [FFI; (45); Italian version (56)] is an audio- or videotaped age-adapted semi-structured interview to assess attachment representations in children and adolescents from 10 to 17 years of age. The child is asked about different relationships with potential attachment figures in adolescence, such as parents, but also friends, sibling(s), and at school. The FFI coding system is based on the Adult Attachment Interview's one (42), but it is different because the FFI allows both a categorical and a dimensional assessment of the attachment. Indeed, scores (0–4 points) are assigned on several scales in different domains (coherence, reflective functioning, self-esteem, relationship with the best friend and with siblings, affective regulation strategies, and differentiation of parental representations), and on the basis of these scores, the rater assigns a score on each scale for the attachment

patterns, corresponding to the traditional four categories: *Secure-Autonomous* (S/F), indicative of a coherent narrative, where the person shows flexibility, the capacity to need and miss others, the value of attachment relationships, high adaptive response, and little or no psychological defenses; *Insecure-Dismissing* (Ds), indicative of poorly coherent narratives due to minimization of the attachment, idealization, or derogation of the self or the attachment figures, and excessive attention to instrumental aspects of the relationships; *Insecure-Preoccupied* (E), indicative of low coherence and inflexibility due to anxious hypervigilance within attachment relationships and age-inappropriate responses of anger, role reversal or passivity in discussing attachment experiences with parents; *Insecure-Disorganized* (D) when the incoherent narrative reflects the lack of an organized attachment strategy or simultaneous incompatible and contradictory strategies (e.g., Ds and P) and the presence of bizarre or frightening content in the IWMs that derives from potentially traumatic experiences, which seems unresolved. The best-fit attachment category is assigned based on the higher score in the four scales for such attachment patterns. The last version [V5, (61)] used in this study contains two additional questions to investigate the effects of the pandemic on the attachment relationships (“Due to the current situation of the pandemic emergency, have you experienced the loss of people important for you (relatives, e.g., grandfather, friends)?,” “Due to the current situation of the pandemic emergency, have there been changes in the relationship with your parents?”), added in agreement with the author H. Steele.

In this study, all interviews were videotaped and transcribed verbatim, covering all the names of people, animals, and places to ensure the participants' privacy. All interviews were coded by two independent certified reliable coders (the first and the last author), with 94% agreement on both secure-insecure and four-way classifications ($k = 0.86$, $p < 0.001$) and 100% on organized-disorganized ones ($k = 1$, $p < 0.001$). A third independent certified coder resolved any disagreements between the two coders. Pearson interrater correlations on FFI pattern scales were all significant (all $p < 0.001$), and the final score used in this study was the average scores between those assigned by the first and second rater.

The FFI shows good psychometric proprieties (56, 62–65). Cronbach's α for the reliability was 0.74 in this study.

Analytic Plan

SPSS version 25 has been used to perform all statistical analyses, and the results were considered statistically significant with $p < 0.05$, reporting 95% Confidence Intervals [CI] when appropriate. All analyses inclusive of questionnaires were performed on the whole sample ($N = 62$), while analyses inclusive of the FFI were performed on the subgroup with data available ($n = 29$), already checked as being homogeneous with the larger group (see above, participants' section).

According to cut-off scores in the literature, prevalence rates were defined, considering the T scores for the YSR and the raw scores for the BES. The chi-square test was employed to compare pandemic and pre-pandemic groups on the percentage

distribution of attachment categories in the FFI (56), reporting Cramer's phi (ϕ) and Odds ratio [OR] as measures of effect size. The t -test was used to an initial control for gender's effect, by comparing scores of boys and girls in all study variables; then, pandemic and pre-pandemic Italian groups on YSR, BES, SMDS, and FFI pattern scores, reporting descriptive statistics (M and SD) and group size for all comparisons groups [(10, 23, 56) see Participants and Table 1].

The Pearson's r correlation coefficient was employed to preliminarily check the age's effect on all study variables and explore relationships among them. General linear models were performed to examine the role of problematic social media usage and attachment patterns on participants' scores for emotional-behavioral symptoms and binge-eating attitudes, reporting partial eta squared (η^2) and observed power.

RESULTS

Preliminary Analyses

Girls and boys did not show differences in YSR, BES, SMDS, and FFI pattern scores, all $p > 0.191$. In line with the literature, older adolescents showed more internalizing problems, $r = -0.273$, $p = 0.032$, specifically more anxiety, $r = -0.253$, $p = 0.047$.

Prevalence and Differences With Pre-pandemic Adolescents in Emotional-Behavioral Symptoms, Binge-Eating Attitudes, Problematic Social Media Usage, and Attachment Representations

Regarding emotional-behavioral symptoms, the t -scores of six participants (9.4%) exceeded the cut-off t -scores for clinical risk in each category of total, internalizing and externalizing problems.

In terms of the prevalence of *binge eating*, three participants (4.8%) were at risk for moderate binge eating, and none showed clinical risk.

Table 1 shows all comparisons between pandemic and pre-pandemic adolescents.

As shown in Table 1, contrary to expectations, pandemic adolescents showed lower levels of emotional-behavioral problems than their pre-pandemic peers, specifically less internalizing ones. However, the pandemic group showed significantly more other problems.

Concerning binge-eating attitudes, pandemic and pre-pandemic adolescents demonstrated no differences in BES scores, which did not confirm the hypothesis.

As hypothesized, pandemic adolescents revealed a more problematic social media usage than pre-pandemic peers.

Lastly, in the subgroup with FFI ($n = 29$), the distribution of attachment categories was 22 (76%) secure and 7 (24%) insecure, all insecure-dismissing, while no participants received insecure-preoccupied or disorganized classifications. The chi-square comparison with the pre-pandemic group (56) revealed no differences in the percentage distribution of secure-insecure classifications, $\chi^2(1) = 1.99$, $p = 0.161$, $\phi = 0.1$ (OR = 1.56, 95%

TABLE 1 | Comparison of scores for emotional-behavioral symptoms^a, binge-eating attitudes^b, problematic social media usage^c, and attachment representations^d between 62 Italian community adolescents during the COVID-19 pandemic and similar pre-pandemic samples^e.

	Pandemic adolescents		Pre-pandemic adolescents		$t_{(df)}$	p	95% CI	
	M	SD	M	SD			LL	UL
YSR/total problems	60.89	25.48	68.10	25.46	2.07 ₍₄₄₂₎	0.040	−4.06	0.36
YSR/internalizing problems	10.94	6.76	17.81	10.22	5.11 ₍₄₄₂₎	0.000	−9.51	−4.23
YSR/externalizing problems	12.23	6.97	12.09	7.32	0.14 ₍₄₄₂₎	0.880	−1.82	2.10
YSR/other problems	12.81	5.54	8.78	4.93	5.86 ₍₄₄₂₎	0.001	2.68	5.38
BES/total score	6.00	5.90	6.40	5.70	0.51 ₍₄₄₎	0.610	−1.97	1.14
SMDS/total score	2.47	2.24	1.65	0.53	7.8 ₍₈₂₁₎	0.000	0.61	1.02
FFI/secure-autonomous	3.08	0.63	2.85	0.80	1.19 ₍₁₂₇₎	0.230	−0.15	0.61
FFI/insecure-dismissing	1.84	0.93	1.80	0.82	1.90 ₍₁₂₇₎	0.841	−0.37	0.45
FFI/insecure-preoccupied	1.32	0.47	1.42	0.58	0.71 ₍₁₂₇₎	0.482	−0.38	0.17
FFI/insecure-disorganized	1.00	0.00	1.14	0.39	1.55 ₍₁₂₇₎	0.121	−0.32	0.04

^aYouth Self Report 11–18 years (YSR).^bBinge Eating Scale (BES).^cSocial Media Disorder Scale (SMDS).^dFriends and Family Interview (FFI), $n = 29$.^eYSR and BES (10), $N = 382$, $M_{age} = 15.6$; SMDS (23), $N = 761$, $M_{age} = 15.5$; FFI (56), $N = 110$, $M_{age} = 14.2$. Significant values are highlighted in bold.

CI 0.84–2.90). As shown in **Table 1**, the pandemic group did not show statistically significant differences with the pre-pandemic group even in the FFI attachment patterns' average scores.

Relationships Among Study Variables

Table 2 shows correlations among study variables, confirming some expected between more problematic social media usage and higher total score of emotional-behavioral symptoms and more binge-eating attitudes. Further, attachment insecurity scales for preoccupation and disorganization showed relations with more internalizing and other problems.

Models of Risk Prediction

Given the correlations, the role of *problematic social media usage* was explored as a potential predictor of more total and externalizing problems and binge-eating attitudes, but no predictive model was statistically significant, all $p < 0.076$.

Problematic social media usage predicted 5.4% more delinquent behaviors, $F_{(1, 60)} = 4.34$, $p = 0.041$, adj. $R^2 = 0.054$ (95% CI 0.01–0.65), $\eta^2 = 0.08$, Observed Power = 0.59; and 5.4% more attention problems, $F_{(1, 60)} = 4.3$, $p = 0.050$, adj. $R^2 = 0.054$ (95% CI 0.01–0.75), $\eta^2 = 0.07$, Observed Power = 0.58.

Concerning the role of attachment, participant's age, the *insecure-preoccupied* and *insecure-disorganized* patterns were entered as predictors of internalizing problems. The final model explained 16.5% of the variance in internalizing problems' scores, $F_{(1, 28)} = 2.84$, $p = 0.05$, adj. $R^2 = 0.165$ (95% CI −34.2 to 36.1), $\eta^2 = 0.00$, Observed Power = 0.05. The analysis of β coefficients revealed the disorganized pattern as a unique significant predictor, $p = 0.040$. Specifically, attachment disorganization was the unique predictor for 17% more somatic complaints, $F_{(1, 28)} = 6.68$, $p = 0.015$, adj. $R^2 = 0.169$ (95% CI −17.9 to 0.27), $\eta^2 = 0.20$, Observed Power = 0.70. Moreover, attachment disorganization was the unique predictor for 11% more social problems, $F_{(1, 28)} = 4.50$, $p = 0.043$, adj. $R^2 = 0.111$

(95% CI −11.9 to 1.5), $\eta^2 = 0.143$, Observed Power = 0.534, and 14.5% more identity-related problems, $F_{(1, 28)} = 33.94$, $p = 0.024$, adj. $R^2 = 0.145$ (95% CI −17.1 to 22), $\eta^2 = 0.17$, Observed Power = 0.64.

Finally, the model with predictor's age and *attachment preoccupation* allowed for the prediction for 15.2% of the variance in anxiety scores, $F_{(1, 28)} = 4.23$, $p = 0.050$, $\eta^2 = 0.07$, Observed Power = 0.26, with no independent significant predictors.

DISCUSSION

In this study, Italian community adolescents have been assessed in emotional-behavioral and binge eating symptoms, problematic social media usage, and attachment representations while confined at home due to the COVID-19 pandemic.

An abnormal event such as a pandemic, characterized by prolonged feelings of fear and uncertainty, was expected to increase adolescents' psychopathological vulnerability. Therefore, in this study, the first aim was to compare the adolescents' prevalence and/or levels of symptoms with similar groups before the pandemic, but most of the results have not confirmed the hypotheses.

From the observation of the prevalence data, the pandemic group did not show more *emotional-behavioral symptoms* than pre-pandemic peers, respectively 9.4 vs. 8.2% in the parent-reported normative sample (57). On the contrary, the comparison with the scores of a similar and more recent group (10) showed that adolescents confined to home showed less emotional difficulties, specifically fewer internalizing symptoms than pre-pandemic peers. Therefore, the vulnerability of these adolescents to anxious-depressive symptoms and somatic complaints may not have increased during the pandemic, as expected based on the literature (1, 3–6, 8, 9). On the contrary, the emotional-behavioral difficulties of an anxious-depressive type

TABLE 2 | Pearson's correlations between scores of emotional-behavioral symptoms^a and binge-eating attitudes^b with problematic social media usage^c and attachment patterns^d in 62 Italian community adolescents during the COVID-19 pandemic.

	SMDS	FFI/Secure-autonomous	FFI/Insecure-dismissing	FFI/Insecure-preoccupied	FFI/Insecure-disorganized
YSR/total problems	0.23*	−0.04	−0.08	0.106	0.27
YSR/internalizing problems	0.19	−0.03	−0.09	0.48*	0.37*
Withdrawal/depression	0.21*	−0.25	0.10	0.01	0.08
Anxiety	0.24*	−0.12	0.02	0.17*	0.28
Somatic complaints	0.03	0.07	−0.10	0.05	0.44**
YSR/externalizing problems	0.24*	0.06	−0.21	0.07	0.19
Aggressive behaviors	0.19	0.08	−0.19	0.15	0.20
Delinquency	0.28*	0.03	−0.20	−0.06	0.17
YSR/other problems	0.18	−0.02	−0.00	−0.03	0.13
Social problems (e.g., binge drinking)	0.24*	−0.07	0.05	0.22	0.38*
Thought problems (e.g., suicidality)	0.26*	−0.15	−0.02	0.01	0.07
Attention problems	0.27*	−0.04	−0.08	0.12	0.12
Identity-related problems (e.g., self-destructive)	0.20	−0.23	0.15	−0.01	0.42*
BES/total	0.23*	0.16	−0.17	−0.12	−0.18

* $p < 0.05$. ** $p < 0.01$.

^aYouth Self Report 11–18 years (YSR).

^bBinge Eating Scale (BES).

^cSocial Media Disorder Scale (SMDS).

^dFriends and Family Interview (FFI), $n = 29$.

seem to have decreased, in line with the Co-SPACE study (12) findings. These results also align with those of national studies, where Italian teenagers appeared only moderately anxious, different from teenagers in international studies (14, 15, 34). Perhaps this possible reduction of internalizing symptoms was favored by the slowing down of school rhythms and the blocking of extracurricular activities, which constitute two significant stressors at the basis of anxiety symptoms in adolescence (5, 66). Moreover, contrary to expectations, adolescents probably did not respond to negative feelings prompted by the confinement by seeking comfort in food, as they did not show more binge-eating attitudes than their pre-pandemic peers (11).

Statistical comparison was impossible to perform regarding *binge eating attitudes*, but the prevalence was slightly lower in this group than in peers in the same Italian region before the pandemic [4.8 vs. 6%, (10)]. Therefore, participants adolescents seem to have had healthy eating habits during the pandemic, and future research could investigate whether these habits have become even healthier than before the pandemic, as suggested by other national findings (13). Otherwise, the absence of unhealthy eating behaviors during confinement can be due to a beneficial effect of having home-cooked and regular meals instead of pre-packed meals in the dining-halls, as happened in pre-pandemic adolescents' lives (67).

On the other side, pandemic adolescents showed higher levels of *other problems* and a more *problematic social media usage* than peers before the pandemic.

The first result may suggest that the new generation of adolescents express their discomfort through alternative type symptoms rather than the expected "traditional" internalizing forms, as noted by other authors (10, 68, 69). Indeed, the YSR other problems scale rates social, thought, attentional and

identity-related problems, which are indicative of engagement in common risky behaviors of adolescence: for instance, high scores in social problems indicate conducts of binge drinking, substance abuse, possible bullying in the form of teasing the others, or being teased by the others as a victim, and general withdrawn in social relationships. The scale for thought problems rates symptoms of suicidal ideation and identity-related problems include self-destructive behaviors, e.g., self-cutting, or confusion about gender identity. A future investigation could specify in what syndromes pandemic groups resulted more vulnerable than pre-pandemic ones, e.g., more suicidal ideation rather than gender-identity confusion, and explore possible reasons behind differences. For instance, pre-pandemic literature suggests (68) that self-destructive behaviors can be prompted by interpersonal stress, so a future investigation could explore more deeply whether online forms of communication and social distancing due to pandemic restrictions were perceived by adolescents as an interpersonal source of stress.

The second result aligns with Fernandes et al. (18), suggesting that the increase in social media use during confinement—to follow school lessons or maintain contact with relatives and friends—may have increased problematic use by Italian adolescents, who showed more symptoms of social media disorder than pre-pandemic peers (23). Adolescents' problematic social media usage was also linked to their higher emotional-behavioral symptoms and disordered eating behaviors, confirming the hypotheses based on pre-pandemic literature (27, 70). In particular, teenagers reporting more symptoms for social media disorder in SMDS were more likely to declare attention problems in the YSR, perhaps due to excessive attention focused on social media, which could affect the adolescent's ability to pay attention to other aspects of life,

such as face-to-face relationships with family members and schoolwork (71). Taken together, these results seem to suggest problematic pathways associated to social media usage during the pandemic, rather than support their beneficial effect suggested by other studies (36, 37).

The other factor investigated as possibly related to adolescents' psychopathology during the pandemic was *attachment*. As expected, pandemic adolescents and similar pre-pandemic peers did not show significant difference rates of secure-insecure classifications, supporting the idea that IWMs may tend toward stability even through stressful life events, including a pandemic (39). Future longitudinal studies assessing adolescent's attachment during and after confinement can confirm this hypothesis.

Nevertheless, utilizing continuous scores on attachment patterns enables evaluations based on models of risk assessment, providing valuable information that would not have been obtained by focusing the investigation only on the "traditional" categories of attachment, as defined in the attachment literature. Indeed, it confirmed that IWMs might support or set back the adolescents' adaptation throughout the life span, as more insecurely attached adolescents showed more emotional and behavioral problems during the confinement due to COVID-19, confirming the hypothesis based on the study on Italian adults (55). In general, insecurely-attached teenagers could have been less able than secure ones to share their feelings related to the pandemic, benefiting perhaps less from the reward effects of self-disclosure (40, 72). Specifically, both attachment preoccupation and disorganization scores were related to more internalizing problems, but only the disorganized pattern was predictive of them. Attachment disorganization was also a unique predictor for broader types of syndromes, such as somatic complaints and social and identity-related problems, supporting the meta-analytical importance assigned to this pattern to increase vulnerability the psychopathology of children and adolescents (51). In this case, the frightening COVID-19 situation and the forced confinement with attachment figures within the family may have exposed adolescents lacking an organized attachment strategy to an unmanageable emotional burden (40, 41). Continued exposure to external triggers due to the pandemic and attachment-related emotions may have overwhelmed disorganized teenagers, exacerbating social problems, such as binge-drinking during video calls with friends, or self-destructive attitudes or identity issues (73, 74).

However, even if less relevant than disorganization, the higher preoccupation in attachment was predictive of more anxiety, in line with Moccia et al. (55) study and meta-analytical findings (75, 76). This suggests that adolescents who are hyper-vigilant to signs of attachment and who show age-inappropriate excessive concern for parents' well-being may have been more vulnerable to anxiety than peers with different attachment IWMs (75). If the parents still went out to go to work or go shopping during confinement, the parental outdoor activity exposed more both parents and adolescents to the risk of contracting the virus, which could have also triggered adolescent anxiety. Moreover, friends' forced distance could have sharpened the separation anxiety typical of individuals guided by a preoccupied pattern.

Overall, the current results may suggest two main conclusions: on the one hand, and contrary to expectations, the COVID-19 pandemic and the consequent confinement did not seem to have had severe consequences for the mental health of these Italian adolescents, who have not shown more psychopathological symptoms than their pre-pandemic peers. On the other hand, both the increase in problematic social media usage—prompted by confinement—and attachment insecurity have been confirmed risk factors for adolescents' symptoms, and longitudinal studies should examine their effect during and after the pandemic.

Limitations and Future Directions

This study may be the first to assess adolescents' attachment representations during the pandemic through an age-adapted interview rather than through self-report questionnaires, which may be less sensitive in detecting insecurity and disorganization in adolescents (51). This study also assesses for the first time the adolescents' problematic social media usage during the pandemic, connecting both this aspect and teenagers' attachment with their emotional-behavioral symptoms and binge-eating attitudes. However, these preliminary results are partial and cannot be generalized due to many limitations. At first, the sample size was small since only the participants whose data were already available were selected; in particular, there was little data on teenagers' attachment due to the long time required to code interviews. This limited number of participants also affected the power of the statistical analyses performed. In this regard, a further limitation is the lack of multiple comparison correction, increasing the risk of type 1 errors.

Moreover, despite the absence of gender differences, most participants were girls, which limited the sample's representativeness. Regarding this point, participants and pre-pandemic groups selected slightly differed in gender or age, possibly reducing the magnitude of the results for the comparisons on attachment and social media usage. More extensive studies with participants more balanced for gender and age should examine the role of these demographics, as pre-pandemic literature suggest girls as more secure and older teenagers more secure in attachment, and lower problematic social media usage in boys and at older ages (23, 63).

Second, except for the FFI, all measures were questionnaires, which poses the risk of biases associated with this kind of measure's exclusive use. Third, the mutual relationships between problematic social media usage and attachment representations were not explored, despite the risk of the former being more significant in the case of attachment insecurity; thus, further exploration in this sense could help to detect their possible moderating effects on psychopathology.

Furthermore, other unexplored relationships may have moderated the results obtained, such as the effect of psychopathological symptoms on binge-eating attitudes (10), as well as the relations between the variables here examined with others not investigated, such as the social norms and coping skills, or reflective functioning, or the role of the family in the transmission of the clinical vulnerability (23, 41, 77, 78). For instance, problematic family functioning or excessive parental

distress are related to more teenager's emotional-behavioral problems, and future studies can address these relations during the pandemic (69, 79).

Moreover, pre-pandemic literature suggests several subjective variables associated with those other problems where pandemic participants showed higher rates than pre-pandemic peers. Specifically, teenagers lacking in time-perspective, i.e., with poor integration of past experiences with the present self-representation, and/or lacking of a view of the future, are more likely to show thought problems in the form of suicidal ideation, especially if insecurely-attached (80). Therefore, future studies can investigate this kind of teenagers' symptoms in light of a possible "suspended" view of the future during the confinement due to the pandemic. Further, social problems such as binge drinking and substance abuse, binge eating attitudes, and problematic social media usage have been all related to adolescents' sensation-seeking, which can lead to a risky decision-taking (81–84).

Yet another element that remained unexplored is the effect of the adolescent's brain development, still in progress, on his/her perception of risk related to the pandemic, or even on his/her propensity for problematic use of social media, which future studies could examine. Lastly, a deeper discussion of the prevalence emotional-behavioral and binge eating symptoms was hidden by limited national data in the literature using the same instruments in the same age range. In this regard, the discussion of the results in light of current findings was also limited by scarce studies addressing these variables in adolescents during the pandemic. Further studies are needed to substantiate this

research's results, with larger and more representative samples, possibly using mixed methods to assess all study variables.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Research Ethical Committee (CER), Department of Education Sciences, University of Genoa. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

All authors provided a substantial contribution to the conception and design of the study and the acquisition, analysis, interpretation of data, participated in drafting, critically revising the article, and gave final approval for the version to be submitted.

ACKNOWLEDGMENTS

We thank all participants, their families, and schools for the voluntary participation in this research, and the MSc students for their collaboration in the data collection.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Risk Factors for Anxiety and Depressive Symptoms in Doctors During the Coronavirus Disease 2019 Pandemic

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Background: The purpose of our study was to investigate the prevalence of anxiety and depressive symptoms and their risk factors among doctors during the coronavirus disease 2019 (COVID-19) pandemic.

Methods: A hospital-based survey study was conducted. Anxiety symptoms were assessed using the Self-Rating Anxiety Scale (SAS), and depressive symptoms were assessed using the Self-Rating Depression Scale (SDS). Multivariable logistic regression was used to analyze anxiety and depressive symptoms across independent variables.

Results: A total of 1,521 doctors were included; 11.11% (169/1,521) of the doctors had anxiety symptoms, and 16.90% (257/1,521) had depressive symptoms. Female sex [adjusted odds ratio (aOR), 1.69; 95% confidence interval (CI), 1.21–2.34; $P = 0.002$] and having a minor child (aOR, 2.31; 95% CI, 1.50–3.56; $P < 0.001$) were associated with an increased risk of anxiety symptoms. Female sex (aOR, 1.56; 95% CI, 1.18–2.06; $P = 0.002$) and having a minor child (aOR, 1.48; 95% CI, 1.06–2.01; $P = 0.022$) were associated with an increased risk of depressive symptoms. Older age (aOR, 0.97; 95% CI, 0.98–0.99; $P = 0.008$) was associated with a decreased risk of depressive symptoms.

Conclusions: Anxiety and depressive symptoms have been common mental health problems in doctors during the COVID-19 pandemic. We found that female sex, having a minor child, and younger age were major risk factors for the development of anxiety and depressive symptoms among doctors during the COVID-19 pandemic.

Keywords: COVID-19, anxiety, depression, doctors, mental health

OPEN ACCESS

Edited by:

Richard Porter,
University of Otago, New Zealand

Reviewed by:

Jennifer L. Vande Voort,
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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 29 March 2021

Accepted: 21 May 2021

Published: 18 June 2021

Citation:

He L, Wang J, Zhang L, Wang F,
Dong W and Zhao W (2021) Risk
Factors for Anxiety and Depressive
Symptoms in Doctors During the
Coronavirus Disease 2019 Pandemic.
Front. Psychiatry 12:687440.
doi: 10.3389/fpsy.2021.687440

INTRODUCTION

Since the outbreak of coronavirus disease 2019 (COVID-19) in Wuhan on December 30, 2019 (1), the disease has had a huge impact on all aspects of Chinese society. With the rising number of cases and deaths caused by COVID-19, China has taken some measures to prevent the spread of COVID-19, including quarantine, lockdown, and physical distancing. Because of the prolonged confinement, negative effects on the economy, employment, and public health have been reported during the COVID-19 pandemic. With worries about future uncertainty, concern had been growing about the mental health sequelae of the COVID-19 crisis.

With the increasing number of patients and suspected cases, the burden of clinical treatment has increased. Repeated modifications in infection control procedures and recommendations have increased the uncertainty. In this setting, doctors have been directly involved in the diagnosis and treatment of COVID-19 patients, which puts them at higher risk for chronic stress, psychological distress, and other mental health symptoms including depression, insomnia, stress, anxiety, anger, irritability, and emotional exhaustion. In addition, high workloads, widespread media coverage, lack of specific treatment, and feeling less support could all contribute to the mental strain on these health workers (2). Clinical doctors who provide clinical services must work in high-risk environments. Previous studies have reported that healthcare workers might have higher rates of depression, anxiety, insomnia, obsessive and somatization symptoms, and post-traumatic stress symptoms than non-healthcare workers. During the COVID-19 pandemic, higher levels of anxiety and depression were shown to be positively correlated with stress among healthcare workers (3–5). Gender, living in rural areas, female, low social support, risk of exposure to COVID-19-positive patients, fear of contracting the disease, worry about lack of medical supplies, and long working hours were significantly associated with anxiety and depression among clinical doctors (3, 4, 6–8). In addition, a history of physical symptoms similar to COVID-19 infection (such as cough, sore throat, lethargy, dyspnea, loss of appetite, and myalgia) can also predispose healthcare workers to symptoms of depression, anxiety, stress, and post-traumatic stress (9).

If anxiety and depression are not treated, they might have a negative impact on the health of clinical doctors and alter their ability to properly perform their duties, including treating and preventing COVID-19. Therefore, the aim of the present study was to evaluate the prevalence and risk factors for anxiety and depressive symptoms among clinical doctors at three hospitals during the COVID-19 pandemic.

METHODS

This was a cross-sectional study, which was conducted from January 20 to May 10, 2020, among three hospitals, that is, the Second People's Hospital of Chengdu, Nuclear Industry 416 Hospital, and Yongchuan Hospital. Online survey management software was used in this study to allow the target subjects to post and complete the questionnaire online. The collected data were automatically entered into a spreadsheet. The study population included active full-time staff members at the three hospitals. The demographic variables considered in the analysis were sex, age, education level, marital status, household income, having minor child (yes/no), Social Support Rating Scale (SSRS) score, and working for COVID-19 control and prevention (yes/no).

Anxiety symptoms were assessed using the Self-Rating Anxiety Scale (SAS) (10), which consisted of 20 items that were scored from 1 to 4 (1 = rarely, 2 = occasionally, 3 = frequently, and 4 = always). Fifteen questions were ranked proportionally, with higher scores indicating more severe symptoms and lower scores for the remaining five questions indicating less severe

symptoms. The raw scores were converted to index scores by multiplying by 1.25. The score was defined as follows (10): no anxiety (<50), low anxiety (50–59), moderate anxiety (60–69), and severe anxiety (>70). This scale has good internal consistency with a Cronbach's alpha of 0.931 (11).

Depressive symptoms were assessed using the Self-Rating Depression Scale (SDS) (12), which contained 20 items. The SDS consisted of 10 positive symptoms and 10 negative symptoms questions, and each item was scored from 1 to 4 (1 = none or a little, 2 = sometimes, 3 = most of the time, and 4 = all of the time). The severity of depressive symptoms was measured by a total SDS score $\times$ 1.25. The scores were grouped into four categories (13): no depression (<50), low depression (50–59), moderate depression (60–69), and severe depression (>70).

Clinical doctors were informed that their responses would be confidential and that their leaders and colleagues would not have access to their test results.

STATISTICAL ANALYSIS

The data are presented as numbers (%), or mean values ($\pm$ standard deviation, SD). To identify differences between two groups, Pearson's χ^2 tests were used for categorical variables. Student's *t*-tests were used to compare normally distributed variables. The Mann–Whitney *U*-tests were used to compare non-normally distributed variables. Multivariate logistic regression analysis was performed to identify determinants independently associated with anxiety and depressive symptoms. The results are expressed as adjusted odds ratios (aOR) with their corresponding 95% confidence intervals (CIs). The data were analyzed using SPSS 22 software. $P < 0.05$ was considered statistically significant.

RESULTS

Demographic Characteristic

A total of 1,521 doctors were included in this study, and the mean age of the participants was 42.7 years. Of these, 53.00% (806) were female, and 85.80% (1,305) had an MSc and above education. A total of 52.26% (795) had a minor child, 34.65% (527) were working for COVID-19 control and prevention, and 68.31% (1,039) had household incomes >150,000 Chinese yuan/year.

Risk Factors for Anxiety Symptoms

Based on the SAS results, 169 (11.11%) doctors had anxiety symptoms. The average SAS score of the doctors with anxiety symptoms was 60.53 ± 8.70 , and the average SAS score of the doctors with no anxiety symptoms was 25.68 ± 13.68 . Baseline characteristics of doctors in the no anxiety and anxiety symptoms groups were compared (Table 1). The results showed that age, female sex, and having a minor child had effects on the anxiety symptoms of the doctors, and these differences were statistically significant ($P < 0.05$).

The incidence of anxiety symptoms among the doctors was 11.11%, that among doctors with a minor child was 14.21% (113/795), and that among females was 13.65% (110/806). Among the anxiety symptoms group, 23 doctors had severe

TABLE 1 | Comparison of baseline characteristics between doctors with no anxiety and anxiety symptoms groups.

	No anxiety group (1,352)	Anxiety group (169)	OR (95% CI)	P*
Age, years (mean $\pm$ SD)	42.79 $\pm$ 10.21	42.26 $\pm$ 9.95		0.522
Social Support Rate Scale (SSRS) (mean $\pm$ SD)	38.07 $\pm$ 18.75	36.36 $\pm$ 18.85		0.043
SAS (mean $\pm$ SD)	26.31 $\pm$ 16.69	61.75 $\pm$ 8.53		<0.001
Married, <i>n</i> (%)	1,272 (94.08)	161 (95.27)	1.27 (0.61–2.67)	0.534
Females, <i>n</i> (%)	696 (51.48)	110 (65.09)	1.76 (1.26–2.45)	0.001
Education (MSc and above education), <i>n</i> (%)	1,159 (85.72)	146 (86.39)	1.06 (0.66–1.68)	0.815
Parents, <i>n</i> (%)	1,320 (97.63)	164 (97.04)	0.80 (0.31–2.07)	0.638
Having minor child, <i>n</i> (%)	682 (50.44)	113 (66.86)	1.98 (1.41–2.78)	<0.001
Chronic disease, <i>n</i> (%)	69 (5.10)	10 (5.92)	1.17 (0.59–2.32)	0.653
Working experience in years, <i>n</i> (%)	904 (66.86)	115 (68.05)	1.05 (0.75–1.49)	0.758
Living with family members, <i>n</i> (%)	1,088 (80.47)	144 (85.21)	1.40 (0.90–2.18)	0.139
Working for COVID-19 control and prevention, <i>n</i> (%)	477 (35.28)	50 (29.59)	0.77 (0.54–1.09)	0.142
Household income, Chinese yuan (CNY) > 150,000/year, <i>n</i> (%)	921 (68.12)	118 (69.82)	1.08 (0.77–1.53)	0.654

*Comparison between no anxiety and anxiety symptoms groups. To identify differences between two groups, Pearson's χ^2 test was used for categorical variables. Student's *t*-test was used to compare normally distributed variables. The Mann–Whitney *U*-test was used to compare non-normally distributed variables. Bold indicates *P*-values less than 0.05.

TABLE 2 | Multivariable models showing association between baseline risk factors and anxiety symptoms.

	OR (95% CI)	P*
Female	1.69 (1.21–2.34)	0.002
Having minor child	2.31 (1.50–3.56)	<0.001

*Multivariable adjusted for age, Social Support Rating Scale (SSRS), married, sex, education, parents, having minor child, chronic disease, working experience in years, living with family members, working for COVID-19 control and prevention duration of care time, and household income. Bold indicates *P*-values less than 0.05.

anxiety symptoms, 57 had moderate anxiety symptoms, and 89 had mild anxiety symptoms. The anxiety symptom level of the doctors with a minor child was higher than that of those with no minor child (29.08 ± 16.19 vs. 31.30 ± 18.17 , $P = 0.012$), and the anxiety symptom level in female doctors was higher than that in male doctors (31.05 ± 18.10 vs. 29.34 ± 16.27 , $P = 0.054$); although there was no significant difference, the incidence of anxiety symptoms in female doctors was significantly higher than that in male doctors [13.64% (110/806) vs. 8.25% (59/715), $P = 0.001$].

To further analyze the risk factors for the anxiety symptoms among the doctors, multivariable logistic regression was performed. After age, SSRS, marital status, sex, education, being a parent, having a minor child, chronic disease, working experience in years, living with family members, working for COVID-19 control and prevention, duration of care time, and household income were adjusted for, the results showed that female sex (aOR, 1.69; 95% CI, 1.21–2.34; $P = 0.002$) and having a minor child (aOR, 2.31; 95% CI, 1.50–3.56; $P < 0.001$) were associated with increased risk of anxiety symptoms (Table 2).

Risk Factors for Depressive Symptoms

Based on the SDS results, 257 (16.90%) doctors had depressive symptoms. The average SDS scores of the doctors with depressive

symptoms were 55.46 ± 17.16 , and the average SDS scores of the doctors with no depressive symptoms were 26.42 ± 14.86 . Baseline characteristics of the doctors in the non-depressive and depressive symptoms groups were compared (Table 3). The results showed that age, female sex, having a minor child, and being a parent had effects on depressive symptoms, and the differences between the two groups were statistically significant ($P < 0.05$).

The incidence of depressive symptoms among the doctors was 16.90%, that among those with a minor child was 21.01% (167/795), and that among female doctors was 19.98% (161/806). The incidence of depressive symptoms in doctors with a minor child was higher than that in doctors without a minor child [21.01% (167/795) vs. 12.40% (90/726), $P < 0.001$], and the incidence of depressive symptoms in female doctors was significantly higher than that in male doctors [19.98% (161/806) vs. 13.43% (96/715), $P = 0.001$]. The depressive symptom level between female doctors and male doctors was not significantly different ($P > 0.05$).

To further analyze the risk factors for depressive symptoms among the doctors, multivariable logistic regression was performed. After age, SSRS, marital status, sex, education, being a parent, having a minor child, chronic disease, working experience in years, living with family members, working for COVID-19 control and prevention, duration of care time, and household income were adjusted for, the results showed that female sex (aOR, 1.56; 95% CI, 1.18–2.06; $P = 0.002$) and having a minor child (aOR, 1.48; 95% CI, 1.06–2.01; $P = 0.022$) were associated with an increased risk of depressive symptoms. Older age (aOR, 0.97; 95% CI, 0.98–0.99; $P = 0.008$) was associated with a decreased risk of depressive symptoms (Table 4).

DISCUSSION

In this study, we found that the incidence of anxiety and depressive symptoms among clinical doctors was approximately

TABLE 3 | Comparison of baseline characteristics between doctors with non-depressive and depressive symptoms groups.

	No depression group (1,264)	Depression group (257)	OR (95% CI)	P*
Age, years (mean $\pm$ SD)	43.20 $\pm$ 10.25	40.41 $\pm$ 9.52		<0.001
SSRS (mean $\pm$ SD)	37.80 $\pm$ 18.84	38.25 $\pm$ 18.34		0.924
SDS (mean $\pm$ SD)	26.42 $\pm$ 14.86	55.46 $\pm$ 17.16		<0.001
Married, n (%)	1,186 (93.83)	247 (96.11)	1.62 (0.83–3.18)	0.154
Females, n (%)	645 (51.08)	161 (62.65)	1.61 (1.22–2.12)	0.001
MSc and above education, n (%)	1,075 (85.04)	230 (89.49)	1.65 (1.06–2.57)	0.063
Parents, n (%)	1,239 (98.02)	245 (95.33)	0.41 (0.20–0.83)	0.011
Having minor child, n (%)	628 (49.68)	167 (64.98)	1.88 (1.42–2.48)	<0.001
Chronic disease, n (%)	67 (5.30)	12 (4.67)	0.88 (0.47–1.64)	0.678
Working experience in years, n (%)	847 (67.01)	172 (66.93)	1.00 (0.75–1.32)	0.979
Living with family members, n (%)	1,026 (81.17)	257 (100)	0.94 (0.67–1.31)	0.705
Working for COVID-19 control and prevention, n (%)	429 (33.94)	98 (38.13)	1.20 (0.91–1.58)	0.198
Household income, Chinese yuan (CNY) > 150,000/year, n (%)	860 (68.04)	179 (69.65)	1.08 (0.81–1.44)	0.613

*Comparison between non-depressive and depressive symptoms groups. To identify differences between two groups, Pearson's χ^2 test was used for categorical variables. Student's *t*-test was used to compare normally distributed variables. The Mann–Whitney *U*-test was used to compare nonnormally distributed variables. Bold indicates *P*-values less than 0.05.

TABLE 4 | Multivariable models showing association between baseline risk factors and depressive symptoms.

	OR (95% CI)	P*
Female	1.56 (1.18–2.06)	0.002
Having minor child	1.48 (1.06–2.01)	0.022
Older age	0.97 (0.98–0.99)	0.008

*Multivariable adjusted for age, Social Support Rating Scale (SSRS), married, sex, education, parents, having minor child ≥ 1 , chronic disease, working experience in years, living with family members, working for COVID-19 control and prevention duration of care time, and household income.

11.1 and 16.90%, respectively, which was lower than that of previous studies conducted in other countries (12, 14, 15). Furthermore, we found that female doctors and those who have a minor child were associated with an increased risk of anxiety and depressive symptoms. The results also showed that younger clinical doctors were more likely to experience depressive symptoms.

A previous study showed that in Malaysia, 31.60% of healthcare workers experienced depression and 29.1% had anxiety symptoms during the COVID-19 pandemic (12). A study in Ethiopia showed that the prevalence of COVID-19-related anxiety was 63% (14). In a highly burdened area of northeastern Italy, a study showed that 50.1% of healthcare workers showed anxiety symptoms and 26.6% had moderate depressive symptoms (15). The incidences of anxiety and depressive symptoms among clinical doctors in our study were lower than those in previous studies (12, 14, 15). The possible reasons for these differences were as follows: first, the Chinese government had taken prompt and effective measures to enhance the sense of security of its citizens and to release frequent information on the epidemic. Rapid sharing of epidemic information is an effective way to reduce public panic (16). Second, the government organized professionals to train doctors and provide knowledge

about COVID-19, and therefore, doctors had a high level of understanding regarding COVID-19. The level of COVID-19 knowledge of doctors plays an important role in responding to epidemic crises (17, 18). On the other hand, Sichuan and Chongqing were not at the center of the COVID-19 pandemic.

Doctors are directly involved in the prevention, diagnosis, treatment, and care of COVID-19 patients; in addition, high workloads, lack of specific drugs, and inability to adhere to prevention strategies may contribute to psychological burden on clinicians (19, 20). In China, most doctors have a high workload per day. During the COVID-19 outbreak, high workloads and severe emotional and physical stress may have led to fatigue and decreased performance, ultimately leading to mood disorders. Our findings showed that doctors having a minor child were at risk factor for depressive and anxiety symptoms. Doctors with minor children had to spend more time with their children and care for children's daily lives; in addition, some children had strict online learning courses, and parents had to spend time helping their children, especially young students. Higher work demands and fatigue have been associated with a higher risk of having poor mental health. In China, women may undertake more family work in the family. The present study showed that female doctors showed higher levels of stress than male doctors.

The pandemic disrupted the economic systems in China, and the increased economic burden caused by the novel COVID-19 outbreak became a worrisome issue for individuals, especially among low-income individuals (21). Chengdu and Chongqing are in Western China, where doctors are paid less; half of the doctors (50%) had a monthly salary of between 5,000 and 10,000 RMB, with only 10% paid more than 10,000 RMB per month, and approximately 80% of junior doctors were paid 5,000 RMB or less. Medical workers aged below 40 years had lower occupational titles and faced mental health disorders of anxiety and depression, probably due to insufficient experience in dealing with this type of public health emergency, which is similar to the findings in Taiwan during the SARS outbreak (9). In addition, their incomes

were at a lower level, and therefore, their family economic burden was heavy.

In conclusion, this study investigated the anxiety and depressive states of doctors during the COVID-19 pandemic, and the results revealed that the prevalence of depression and anxiety was high among these doctors. We found that younger age, having a minor child, and female sex were major risk factors for the development of anxiety and depressive symptoms in doctors. These results indicate that leaders should provide psychological counseling and social support to doctors to protect their mental health.

LIMITATIONS

There were several limitations in the current study. First, the self-report questionnaire used in this study may have resulted in response bias from the participants. Although we are aware of this limitation, the research team was unable to conduct face-to-face interviews with the clinicians administered with the questionnaires due to government controls on population movement to prevent the transmission of COVID-19. Second, the participants came from tertiary hospitals in Sichuan and Chongqing, and these areas were not the worst areas regarding COVID-19 outbreaks. As a result, the results may not be generalizable to the entire nation of doctors. Third, we lacked data regarding the prevalence rate of depression and anxiety of doctors in Sichuan and Chongqing before COVID-19. In China, the most populous country and one of the largest developing countries in the world, has significant regional ethnic, linguistic, and cultural diversities. Studies of the mental health of Chinese doctors have had mixed results, and the results could not be used for direct comparison. In addition, due to the absence of

longitudinal follow-up, we do not know how the psychological symptoms changed over time. Despite the limitations of the study, our results provide valuable information on the mental health status of doctors in the face of public health emergencies.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Medical and Health Research Ethics Committee in Second people's Hospital of Chengdu, Nuclear Industry 416 Hospital and Yongchuan Hospital. The patients/participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

AUTHOR CONTRIBUTIONS

LH was responsible for the concept and design of the study, data collection and analysis, and the first draft of the paper and further manuscript. JW was responsible for the concept and design of the study, the data analysis, and the interpretation. LZ and FW were responsible for the data analysis. WD was responsible for overseeing the concept and design of the study, the data analysis, and the interpretation. All authors read and approved the final manuscript for publication.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Psychological Effects of People Isolated in Hubei Due to COVID-19 Epidemic

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OPEN ACCESS

Edited by:

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Reviewed by:

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 22 August 2020

Accepted: 30 June 2021

Published: 28 July 2021

Citation:

Gong J, Chen G, Qi Z, Zhong S, Su T,
Pan Y, Wang J, Huang L and Wang Y
(2021) Psychological Effects of People
Isolated in Hubei Due to COVID-19
Epidemic.
Front. Psychiatry 12:597894.
doi: 10.3389/fpsy.2021.597894

The Coronavirus Disease 2019 (COVID-19) epidemic broke out from Wuhan in Hubei province, China, spread nationwide and then gradually developed into other countries in the world. The implementation of unprecedented strict isolation measures has affected many aspects of people's lives and posed a challenge to psychological health. To explore whether people isolated for 14 days due to having contact with COVID-19 patients had more psychosocial problems. We conducted an online survey from February 29 to March 10, 2020. Depression, anxiety, post-traumatic stress disorder (PTSD) symptoms, and coping style were assessed by the Patient Health Questionnaire-9 (PHQ-9), 7-item Generalized Anxiety Disorder Scale (GAD-7), Impact of Event Scale-Revised (IES-R), and Simplified Coping Style Questionnaire-20-Chinese Version. This study included 1,315 isolated respondents in Hubei province (58.5% located in Wuhan). 69.3% respondents isolated at home, 30.7% respondents isolated at centralized quarantined spot. Of all respondents, 66.8% reported depressive symptoms, 49.7% reported anxiety symptoms, 89.0% reported PTSD symptoms. The Cronbach α of the IES-R, PHQ-9, GAD-7, and total SCSQ-20 were 0.935, 0.847, 0.843, and 0.888, respectively. Persons who isolated at home were associated with a lower risk of PTSD, depressive and anxiety symptoms ($P < 0.01$). People who knew someone to have COVID-19 were associated with severe symptoms of PTSD symptoms ($P = 0.001$). As for coping style, higher level of passive coping style was associated with severe symptoms of PTSD, depression and anxiety ($P < 0.001$). Our findings identify that person isolated during the COVID-19 epidemic was associated with high proportion of depression, anxiety, and PTSD symptoms. Public health officials should be aware of and prepared to take necessary measures.

Keywords: coronavirus, epidemic, psychological effects, isolation, anxiety

INTRODUCTION

Coronavirus Disease 2019 (COVID-19), formerly known as 2019 novel coronavirus was first identified in late December 2019 in Wuhan City in China (1). From the end of December 2019, COVID-19 began to spread rapidly throughout Hubei Province and other areas in China, now it has exploded all over the world (2). As of March 18th, 2020, according to the National Health Commission (<https://news.qq.com/zt2020/page/feiyang.htm>), there were 179,180

people had been diagnosed with COVID-19 cases worldwide, including 81,163 in China, and 83.5% of them happened in Hubei province. So far, more than 4% infected patients had died from this new viral infection (<https://news.qq.com/zt2020/page/feiyang.htm>), mainly due to pneumonia and other respiratory complications such as septic shock, acute respiratory distress syndrome, acute kidney injury, disseminated intravascular coagulation and so on (3).

At present, the prevalence of COVID-19 is causing fear and panic, and the society urgently needs to know the mental health status in time (4). Prior research has revealed a deep and wide range of psychosocial impacts [post-traumatic stress disorder (PTSD), depression, generalized anxiety disorder, panic disorder, and substance abuse] on people at the individual, community, and international levels during outbreaks of infection (5–7). Especially, isolation separates persons may have been in close contact with a confirmed or suspected case of coronavirus (and thus at risk for disease) from the general public. For the sake of greater public good, isolation may bring heavy economic, emotional, and psychological problems for some people. During the Middle East Respiratory Syndrome (MERS) epidemic, the prevalence of anxiety symptoms and anger in persons isolated were examined (5). According to our research, most of the studies related to this outbreak have focused on identifying the epidemiological and clinical characteristics of infected patients (8, 9), the genomic characterization of the virus (10), psychological distress among medical staff (11) and general population (12, 13). However, there are no researches investigating the psychological impact on the isolated population due to risk of infection during the COVID-19 epidemic.

The objective of this psychological impact survey was to seizure a range of responses (including depression, anxiety, and PTSD symptoms) of isolated persons in Hubei within the past month and a half of the COVID-19 outbreak to better understand their psychologic status and potential danger. This may be helpful for government agencies and healthcare professionals to protect the mental health of the public, particular the isolated individuals, in the face of COVID-19 outbreak expansion in China and around the world. We hypothesized that a number of respondents had moderate-to-severe depression, anxiety and PTSD symptoms, and the risk factors (the causes and conditions that lead to or increase the chance of risk accidents or enlarge the scope of loss) for the psychological impact might relate to isolation places, knowledge of the disease, knew someone to have Covid-19, and occupation.

METHODS

Setting and Participants

We used a cross-sectional survey design and anonymous online questionnaire composed of 75 single choice and short-answer questions to evaluate the demographic characteristics, isolated places, contact history, knowledge of COVID-19 and immediate psychological response of isolated population in Hubei Province during the prevalence of COVID-19. Since the incubation period of COVID-19 is range from 1–14 days, isolated individuals who may have been in close contact with confirmed cases during

the period of 14 days were isolated for 2-week in the homes or centralized quarantined spots. Each person was isolated in one single room. Isolated persons were asked not to leave their quarantined areas or have visitors, and instructed to measure their temperature twice daily. If any symptoms of COVID-19 developed (sore throat, a cough, fever, tiredness, or shortness of breath), they were to call hospital for urgent assessment. Every respondent had his or her own IP address, and at the end of the questionnaire, we would check carefully the IP address and delete the questionnaire with the same IP address. This study was approved by the Ethics Committee of First Affiliated Hospital of Jinan University (Guangzhou, China, Approval Letter: KY-2020-044), and informed, written consents were obtained from all participants.

Survey Instrument

The psychological impact of isolation was evaluated with validated scales, including the Chinese version Patient Health Questionnaire-9 (PHQ-9), the 7-item Generalized Anxiety Disorder Scale (GAD-7), the Impact of Event Scale-Revised (IES-R), and the Simplified Coping Style Questionnaire-20 (SCSQ-20) (14). The PHQ-9 is a nine-item questionnaire, each with a Likert rating scale from 0 to 3, designed to screen for depression in primary care and other medical settings (15). The maximum score is 27. The standard cut-off score for screening to identify moderate-severe depression is 10 or above, which was established in the first study on the PHQ-9 (16). Item 9 of the PHQ-9 evaluates passive thoughts of death or self-injury within the last 2 weeks, and is often used to screen depressed patients for suicide risk (17). GAD-7 is composed of 7-item highly relevant questions with 4-point Likert scoring system from 0 to 3, which is a self-administered test to assess generalized anxiety disorder. The maximum total score is 21. In this study, the total score ≥ 10 points was used as the cutoff score for moderate anxiety symptoms, and the individuals with that score were categorized into the anxiety group (17). The IES-R is a self-report measure designed to assess current subjective distress resulting from a traumatic life event and is composed of 22 items, each with a Likert rating scale from 0 to 4. The maximum score is 88. The standard cut-off score for screening to identify possible PTSD symptoms is 20 (6, 18). The SCSQ-20 is a 20-item self-report questionnaire that includes two dimensions, active coping (12 items) and passive coping (8 items), each with a Likert rating scale from 0 “never” to 3 “very often.”

Statistical Analysis

Descriptive statistics were calculated for demographic characteristics, psychological symptoms, isolated places, contact history, knowledge of COVID-19, and concern-related variables by using SPSS statistical software 19.0 (SPSS, Chicago, IL, USA). The original scores of the IES-R, PHQ-9, GAD-7, active coping and passive coping were not normally distributed and so are presented as median with interquartile ranges (IQRs). For categorical variables, group proportions were calculated according to the number of respondents per response with respect to the number of total responses of a question. The nonparametric Mann–Whitney *U*-test and Kruskal–Wallis test

were applied to compare the symptoms of PTSD, depression, anxiety, active coping and passive coping. The Cronbach α coefficient was calculated to evaluate the internal consistency of the responses given to the scale. Cronbach α is unreliable between 0.0 and 0.40, low reliable between 0.40 and 0.60, quite reliable between 0.60 and 0.80, and highly reliable between 0.80 and 1.00. The P -value is accepted as <0.05 as the statistically significant level. To identify potential risk factors for symptoms of PTSD, depression and anxiety in isolated respondents, multivariable logistic regression analysis was performed, and the odds ratios (ORs) and 95% confidence intervals (CIs) were obtained from logistic regression models, after adjustment for confounders, including sex, age, education level, marital status, occupation, isolation places, geographic location in Wuhan or not, knowledge of epidemic, knew someone to have COVID-19, active coping and passive coping. A score of ≥ 10 on the PHQ-9 was used to estimate the prevalence of depressive symptoms. A score of ≥ 10 on the GAD-7 was used to estimate the prevalence of anxiety symptoms. A score of ≥ 20 on the IES-R was used to estimate the prevalence of PTSD symptoms.

RESULTS

Demographics and Description of Isolated Persons

This study received a total of 1,711 questionnaires from Hubei province, 396 questionnaires not filled out completely correctly were excluded, leading to inclusion of 1,315 valid questionnaires with no missing data. Demographic characteristics are presented in **Table 1**. Among all the isolated persons, the majority of respondents were men (59.3%), aged 26–35 years (50.8%), geographic location in Wuhan (58.5%), married (68.3%), worse educated ($54.1\% \leq$ senior high school), self-employed (40.4%), know well of the epidemic (57.1%), isolation at home (69.3%), knew someone to have COVID-19 (63.3%).

Psychological Impact and Coping Style

The psychological impact of COVID-19 outbreak, measured using the IES-R scale, revealed a sample median score of 39.0, IQR (30.0–47.0). Almost 89.0% of the respondents experienced PTSD symptoms. Depression level of respondents was measured by PHQ-9 scale, revealed a sample median score of 12.0, IQR (8.0–14.0), 879 (66.8%) rated moderate-severe depression. According to PHQ-9 item 9, 515 (39.2%) were considered to be with suicide and self-injury risk. Respondents' anxiety levels, measured using the GAD-7 item scale, revealed a sample median score of 9.0, IQR (6.0–12.0). Of all respondents, 654 (49.7%) were considered to suffer from moderate-severe anxiety. The coping style of all respondents by using SCSQ-20 scale revealed a sample median score of 20.0, IQR (16.0–24.0) of active coping style, 13.0, IQR (10.0–15.0) of passive coping style. Moreover, people isolated at centralized quarantined spots had higher IES-R, PHQ-9, GAD-7, and passive coping scores, than those isolated at home. Persons who knew someone to have COVID-19 (including family and friends) had higher IES-R, active and passive coping scores. Persons who were very familiar with the epidemic had higher scores in IES-R, active coping, and passive coping. The

TABLE 1 | Characteristics of isolated persons who responded to the survey.

Characteristic	No. (%) (N = 1,315)
Gender	
Male	780 (59.3)
Female	535 (40.7)
Age	
<18	27 (2.0)
18–25	364 (27.7)
26–35	668 (50.8)
36–45	222 (16.9)
46+	34 (2.6)
Education	
Senior high school or below	711 (54.1)
Bachelor's degree or above	604 (45.9)
Geographic location	
Wuhan	769 (58.5)
Other cities in Hubei	546 (41.5)
Occupation	
Medical staff	62 (4.7)
Students	111 (8.4)
Self-employed	532 (40.4)
Farmers	162 (12.3)
Employed	384 (29.2)
Unemployed	64 (4.9)
Marital status	
Single or divorced or widowed	417 (31.7)
Married	898 (68.3)
Knowledge of the epidemic	
Don't know much	127 (9.7)
Know well	751 (57.1)
Very familiar with	437 (33.2)
Isolation places	
At home	911 (69.3)
At centralized quarantined spot	404 (30.7)
Know someone to have COVID-19	
Yes	832 (63.3)
No	483 (36.7)
Relationship with infected patients	
Man and wife	117 (14.1)
Parents	175 (21.0)
Offsprings	106 (12.7)
Brothers and sisters	97 (11.7)
Friends	331 (39.8)
Others	6 (0.7)

mean IES-R, PHQ-9, GAD-7, active coping, and passive coping scores were not different for male or female ($P > 0.05$). Persons aged 36–45 years had higher passive coping scores; married and well-educated respondents had higher active and passive coping scores. All the above differences were statistically significant ($P < 0.05$; **Table 2**; **Supplementary Table 1**).

TABLE 2 | Prevalence of PTSD, depressive, anxiety symptoms, and coping style according to respondents' demographics.

Characteristic	No. (%) (<i>N</i> = 1,315)	Total score, median (IQR)	
Prevalence			
IES-R, PTSD symptoms		39.0 (30.0–47.0)	
<20	145 (11.0)		
≥20	1,170 (89.0)		
PHQ-9, depressive symptoms		12.0 (8.0–14.0)	
<10	436 (33.2)		
≥10	879 (66.8)		
PHQ-9, depressive symptoms			
0–4 (Normal)	158 (12.0)		
5–9 (Mild)	278 (21.1)		
10–14 (Moderate)	563 (42.8)		
15–27 (Severe)	316 (24.0)		
GAD-7, anxiety symptoms		9.0 (6.0–12.0)	
<10	661 (50.3)		
≥10	654 (49.7)		
GAD-7, anxiety symptoms			
0–4 (Normal)	226 (17.2)		
5–9 (Mild)	435 (33.1)		
10–14 (Moderate)	555 (42.2)		
15–21 (Severe)	99 (7.5)		
SCSQ-20, coping styles			
Active coping		20.0 (16.0–24.0)	
Passive coping		13.0 (10.0–15.0)	
Isolation places	Median (IQR)	<i>P</i> -value	<i>Z</i> -value
IES-R		0.005	−2.814
Home (<i>n</i> = 911)	38.0 (28.0–47.0)		
Centralized quarantined spot (<i>n</i> = 404)	40.0 (33.0–47.8)		
PHQ-9		< 0.001	−5.482
Home	11.0 (7.0–14.0)		
Centralized quarantined spot	13.0 (10.0–15.0)		
GAD-7		< 0.001	−4.199
Home	9.0 (6.0–11.0)		
Centralized quarantined spot	10.0 (7.0–12.0)		
Passive coping		0.029	−2.181
Home	13.0 (10.0–15.0)		
Centralized quarantined spot	13.0 (11.0–15.0)		
Know someone to have COVID-19	Median (IQR)	<i>P</i> -value	<i>Z</i> -value
IES-R		<0.001	−4.724
Yes (<i>n</i> = 832)	40.0 (31.0–49.0)		
No (<i>n</i> = 483)	37.0 (28.0–44.0)		
Active coping		<0.001	−4.166
Yes	21.0 (17.0–25.0)		
No	19.0 (15.0–22.0)		
Passive coping		<0.001	−4.151
Yes	13.0 (11.0–16.0)		
No	12.0 (10.0–15.0)		

(Continued)

TABLE 2 | Continued

Knowledge of the epidemic	Median (IQR)	P-value	
IES-R		0.022	7.659
Don't know much (<i>n</i> = 127)	36.0 (30.0–45.0)		
Know well (<i>n</i> = 751)	39.0 (31.0–45.0)		
Very familiar with (<i>n</i> = 437)	41.0 (28.0–52.0)		
Active coping		<0.001	129.678
Don't know much	18.0 (15.0–21.0)		
Know well	19.0 (16.0–22.0)		
Very familiar with	23.0 (18.0–28.0)		
Passive coping		<0.001	44.217
Don't know much	13.0 (10.0–14.0)		
Know well	12.0 (10.0–15.0)		
Very familiar with	14.0 (11.0–17.0)		

Internal consistency

The Cronbach α for the IES-R, PHQ-9, GAD-7, SCSQ-20 active coping, SCSQ-20 passive coping, and total SCSQ-20 coping adapted in the study were 0.935, 0.847, 0.843, 0.863, 0.779, and 0.888, respectively. Thus, it can be said that all scales are reliable tools.

Risk Factors of PTSD, Depressive, and Anxiety Symptoms

According to the results of multivariable logistic regression analysis, after controlling for other confounders including sex, age, education level, marital status, and occupation, persons who isolated at home was associated with a lower risk of PTSD, depressive and anxiety symptoms (OR = 0.61, 95% CI: 0.39–0.96, P = 0.031; OR = 0.59, 95% CI: 0.45–0.79, P < 0.001; OR = 0.68, 95% CI: 0.53–0.88, P = 0.003). Persons who knew someone to have COVID-19 were associated with severe symptoms of PTSD symptoms (OR = 1.94, 95% CI: 1.32–2.87, P = 0.001). As for coping style, higher level of passive coping style (OR = 1.23, 95% CI: 1.17–1.29, P < 0.001; OR = 1.17, 95% CI: 1.13–1.21, P < 0.001; OR = 1.13, 95% CI: 1.09–1.17, P < 0.001) was associated with severe symptoms of PTSD, depression and anxiety. Compared with unemployed, students (OR = 4.08, 95% CI: 1.36–12.24, P = 0.012; OR = 2.08, 95% CI: 1.04–4.17, P = 0.039), farmers (OR = 2.63, 95% CI: 1.08–6.43, P = 0.034; OR = 2.62, 95% CI: 1.37–4.99, P = 0.004) and employed (OR = 2.26, 95% CI: 1.05–4.87, P = 0.037; OR = 2.44, 95% CI: 1.36–4.37, P = 0.003) were associated with severe symptoms of PTSD and depression. And medical staff (OR = 2.46, 95% CI: 1.11–5.45, P = 0.026) and self-employed (OR = 2.04, 95% CI: 1.15–3.60, P = 0.014) were also associated with severe symptoms of depressive symptoms. Additionally, men were associated with severe symptoms of depressive symptoms than women (OR = 1.41, 95% CI: 1.09–1.81, P = 0.009). Compared with didn't know much of the epidemic, persons who knew well the epidemic were associated with severe depressive symptoms (OR = 1.63, 95% CI: 1.07–2.47, P = 0.022). Persons who were geographic location in Wuhan were associated with a lower risk of anxiety symptoms

(OR = 0.77, 95% CI: 0.61–0.98, P = 0.031). Compared with married, single or divorced or widowed was associated with a lower risk of anxiety symptoms (OR = 0.74, 95% CI: 0.57–0.97, P = 0.030) (Table 3).

DISCUSSION

The median incubation period of COVID-19 is an average of 5–6 days (1–14 days), so symptoms typically occur a minimum of 1 day or a maximum of 14 days after exposure to the coronavirus (19). Thus, people who have been in close contact should be monitored closely for at least 14 days for occurrence of symptoms. Our results show that a substantial proportion of isolated persons experienced psychological problems, as evidenced by the proportion that display symptoms of depression (66.9%), anxiety (49.8%), and PTSD (89.0%) symptoms as measured by validated scales. With respect to the recent global outbreak of COVID-19, considerable time has been spent discussing the specifics of isolation and how to promote adherence to infection control measures. Little, if any, analysis has focused on the effect of isolation on the psychological health of the isolated person. This knowledge is critical if modern isolation is to be an effective disease-containment strategy. To our knowledge, a consideration of the adverse psychological effects of isolated populations in Hubei has not previously been systematically endeavored since the outbreak of COVID-19.

The prevalence of depression, anxiety and PTSD symptoms in our study population was higher than that reported during the outbreak of SARS (6, 20), MERS (5), and Ebola (21). The current COVID-19 outbreak is different to the prior SARS or MERS, which is creating a confused and rapidly evolving situation. It has stronger human-to-human transmission capability, and it can even be transmitted through asymptomatic individuals, while the health authorities had insufficient preparedness to address the outbreaks, thus there is greater unpredictability and can cause more panic. Despite much higher case-fatality rate (CFRs) for SARS and MERS, COVID-19 has led to more total deaths due to the large number of cases, the CFR was as much as

TABLE 3 | Results of multivariate logistic regression analyses.

Variable	No. of severe cases/no. of total cases (%)	OR (95% CI)	P-value
IES-R, PTSD symptoms			
Isolation places			
Home	797/911 (87.5)	0.61 (0.39–0.96)	0.031
Centralized quarantined spot	373/404 (92.3)	1 [Reference]	NA
Know someone to have COVID-19			
Yes	762/832 (91.6)	1.94 (1.32–2.87)	0.001
No	408/483 (84.5)	1 [Reference]	NA
Passive coping	NA	1.23 (1.17–1.29)	<0.001
Occupation			
Medical staff	56/62 (90.3)	2.36 (0.76–7.38)	0.140
Students	104/111 (93.7)	4.08 (1.36–12.24)	0.012
Self-employed	464/532 (87.2)	1.78 (0.86–3.69)	0.120
Farmers	149/162 (92.0)	2.63 (1.08–6.43)	0.034
Employed	347/384 (90.4)	2.26 (1.05–4.87)	0.037
Unemployed	50/64 (78.1)	1 [Reference]	NA
PHQ-9, depressive symptoms			
Isolation places			
Home	574/911 (63.0)	0.59 (0.45–0.79)	<0.001
Centralized quarantined spot	305/404 (75.5)	1 [Reference]	NA
Passive coping	NA	1.17 (1.13–1.21)	<0.001
Gender			
Male	541/780 (69.3)	1.41 (1.09–1.81)	0.009
Female	338/535 (63.2)	1 [Reference]	NA
Occupation			
Medical staff	43/62 (69.3)	2.46 (1.11–5.45)	0.026
Students	73/111 (65.8)	2.08 (1.04–4.17)	0.039
Self-employed	347/532 (65.2)	2.04 (1.15–3.60)	0.014
Farmers	117/162 (72.2)	2.62 (1.37–4.99)	0.004
Employed	276/384 (71.9)	2.44 (1.36–4.37)	0.003
Unemployed	32/64 (50.0)	1 [Reference]	NA
Knowledge of the epidemic			
Don't know much	76/127 (59.8)	1 [Reference]	NA
Know well	522/751 (69.5)	1.63 (1.07–2.47)	0.022
Very familiar with	281/437 (64.3)	1.01 (0.64–1.58)	0.979
GAD-7, Anxiety symptoms			
Isolation places			
Home	422/911 (46.3)	0.68 (0.53–0.88)	0.003
Centralized quarantined spot	232/404 (57.4)	1 [Reference]	NA
Geographic location			
Wuhan	358/769 (46.5)	0.77 (0.61–0.98)	0.031
Other cities in Hubei	296/546 (54.2)	1 [Reference]	NA
Active coping	NA	1.04 (1.01–1.06)	0.002
Passive coping	NA	1.13 (1.09–1.17)	<0.001
Marital status			
Single or divorced or widowed	186/417 (44.6)	0.74 (0.57–0.97)	0.030
Married	468/898 (52.1)	1 [Reference]	NA

49.0% among critical cases (the overall CFR was 2.3%) (22), nevertheless, no proper treatment or vaccine is available for the epidemic. To reduce potential transmission from exposed persons before symptoms occur so as to lower the risk of further disease transmission, who may have been in close contact with confirmed or suspected cases during the period of 14 days were isolated for 2-week in the homes or centralized quarantined spots. This takes a considerable toll on the person. Those in isolation might experience boredom, loneliness, anger, guilt about the effects of contagion, quarantine, and stigma on their families and friends (4), could lead to mental distress, persistent anxiety and depression, panic attacks, psychomotor excitement, psychotic symptoms, delirium, and even suicidality as reported in the early phase of the SARS outbreak (23). We identified for increased depression, anxiety and PTSD symptoms in the quarantined persons at the centralized quarantined spot and those with infected patients around, which brought benefits and challenges to the prevention and control of COVID-19. It is noteworthy that unemployed persons were less at risk of PTSD and depression, probably because they didn't worry about delays in work time and subsequent deprivation of their anticipated income due to virus exposure in public transportation (24). While, people who knew well about the epidemic was associated with a higher risk of depression, probably because they tend to obtain a large amount of information that can easily trigger stress (25).

A score of ≥ 20 on the IES-R was used to estimate the prevalence of PTSD symptoms based on the study of journalists working in war zones (18) and SARS control and psychological effects of quarantine (6). While other cutoff points may have been used to estimate the prevalence of PTSD symptoms (26, 27), what we identified was increased risk factors for PTSD symptoms, rather than the absolute prevalence of PTSD in our study participants, which is the important findings of this study. In this survey, the presence of PTSD symptoms was up to 89% and highly positively associated with one's depression, anxiety, and passive coping styles. According to Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5), the diagnostic criteria for PTSD are as follows, the individual has been exposed to a traumatic event that combines two factors: A1 the individual has witnessed or encountered one or more physical deaths involving himself or others, or has been threatened with death, or has been severely injured, or has been threatened with physical integrity; A2 the individual's reactions include intense fear, helplessness, or panic. People who knew someone to have COVID-19 are related to the increase of PTSD symptoms, probably because of high self-awareness of their health, more worries about relatives and friends, and more exposure to the threat of death (28). Progression of depression and anxiety symptoms experienced in the early stages of natural disaster can be prevented by early mental health care (29). However, these symptoms evolve into long-term PTSD without early intervention. This study also noted the trend toward increasing symptoms of both PTSD and depression as the passive coping of the respondent. Active coping styles reduce psychological problems, while passive coping styles increase mental issues (30). Isolated persons with risk factors for either anxiety, depression or

PTSD symptoms may benefit from increased support from public health officials. Relief materials must be provided in a timely manner during the period of isolation. Accurate information about the symptoms of the disease should be publicly available, and psychological support is needed for patients who have persistent symptoms even after the isolation is removed. Any financial loss should be recognized and appropriately supported. Psychological support is necessary for people with a history of mental illness because they are more likely to experience mental symptoms. Medical management plan should be provided for patients with persistent symptoms.

Although isolated persons underwent symptoms suggestive of depression, anxiety and PTSD, the scales used to measure these symptoms are not sufficient to confirm these diagnoses. Structured diagnostic interviews are required to confirm the diagnoses of depression, anxiety and PTSD. This was not possible because the survey was anonymous. And it's worth mentioning that we found 515 (39.2%) isolated persons were considered to be with suicide and self-injury risk through item 9 of PHQ-9. Though previous study suggested that item 9 of the PHQ-9 was an insufficient assessment tool for suicide risk and suicide ideation (17), the possibility cannot be completely ignored.

We investigated the psychological status and coping styles of isolated populations of the COVID-19 epidemic from 1,315 respondents in Hubei province. The sample size was larger than that of most related studies. Although Hubei province is the birthplace of the epidemic, the isolated populations in other provinces may have similar psychological conditions because of COVID-19. In addition, we can make a comparative study on the psychological status of the isolated populations in Hubei province before and after the blockade in the future. While, there are several limitations in this study. First, the actual number of isolated people is low than the total number of persons who were placed into isolation (the exact number is unknown), so it may not represent of the whole group of isolated persons. However, due to lack of funding, confidentiality of public health records and an overloaded public health response system, the sampling of this studies limited. Second, a self-selection effect may have occurred with those persons who were experiencing the greatest or least levels of distress responding to the survey. Third, respondents need to use a computer or smartphone to respond, suggesting that they may be more educated and socio-economic than the quarantined population as a whole. Fourthly, we didn't indicate the means of communication during isolation with family as with a medical staff, as well as information about the psychiatric history of isolated person. Fifthly, all measures used in this study were based on self-reports, which were very subjective. In addition, the age range of the included participants in this study was mostly from 26 to 35 years old who is very young and is vulnerable to psychological problems, which may bias the conclusions. Finally, we just did a cross-sectional study, and we didn't follow up with people who were quarantined.

CONCLUSION

Our data show that isolation can result in considerable psychological distress in the forms of depressive, anxiety, and PTSD symptoms. Public health officials, infectious diseases physicians, psychiatrists and psychologists need to be aware of this issue. They must strive to identify the factors that affect the success of isolation and infection control measures in disease control and community rehabilitation, and must be prepared to provide additional support to those who are at greater risk of adverse psychological and social consequences of isolation.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

This study was approved by the Ethics Committee of First Affiliated Hospital of Jinan University (Guangzhou, China, Approval Letter: KY-2020-044), and informed, written consents were obtained from all participants.

AUTHOR CONTRIBUTIONS

YW and LH designed the study. JG, GC, ZQ, SZ, TS, YP, and JW contributed to data acquisition. GC and YW contributed to data analysis. JG and GC wrote the manuscript. YW and LH revised the manuscript. All authors contributed and approved the final manuscript.

FUNDING

This study was supported by grants from the National Natural Science Foundation of China (81671670 and 81971597), Project in Basic Research and Applied Basic Research in General Colleges and Universities of Guangdong, China (2018KZDXM009), and Planned Science and Technology Project of Guangzhou, China (201905010003).

ACKNOWLEDGMENTS

We would like to acknowledge all funding organizations and participants of this study.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2021.597894/full#supplementary-material>

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Lock-Down Effect on the Mental Health Status of Healthcare Workers During COVID-19 Pandemic

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Background: The psychological impact that outbreaks and pandemics could inflict on healthcare workers has been widely studied; yet, little is known about the impact of the lockdown measures.

Objectives: To assess the magnitude of depression and anxiety among healthcare professionals before and after lifting of the lockdown restrictions in Saudi Arabia.

Methods: Surveys targeting healthcare workers were circulated twice: during the lockdown, and 8 weeks after lifting of lockdown. Anxiety and depressive symptoms were assessed using Generalized Anxiety Disorder (GAD-7) and Patient Health Questionnaire-9 (PHQ-9) scales.

Results: A total of 947 healthcare workers, with the mean age of (37 ± 8.9) responded to the surveys. Among these, 23–27% respondents reported clinically significant levels of anxiety and depression. Whereas, easing of the lockdown restrictions was shown to be associated with decreasing mean scores of PHQ-9 and GAD-7. The noted burden fell heavily on female workers, those with a current or a history of psychiatric disorders, suffering from chronic diseases, being in workplaces with high exposure to COVID-19 or in contact with COVID-19 patients, nurses, as well as those who were living with elderly and perceived their physical and mental health as “much worse” compared to the time before the pandemic.

Conclusion: Our findings identified several predictors for anxiety and depression at different time-points of the pandemic. Thus, priority to psychological support measures might be needed for these groups.

Keywords: COVID-19, anxiety, depression, healthcare workers, Saudi Arabia

OPEN ACCESS

Edited by:

Richard Porter,
University of Otago, New Zealand

Reviewed by:

Alessandro Cuomo,
University of Siena, Italy
Valerio Dell'Oste,
University of Pisa, Italy

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Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 21 March 2021

Accepted: 21 July 2021

Published: 13 August 2021

Citation:

Fageera W, Babbain F, Alzahrani AS
and Khrad HM (2021) Lock-Down
Effect on the Mental Health Status of
Healthcare Workers During COVID-19
Pandemic.
Front. Psychiatry 12:683603.
doi: 10.3389/fpsy.2021.683603

INTRODUCTION

Living in the midst of one of the major public health crises has fundamentally impacted various aspects of people's lives. The novel coronavirus disease (COVID-19) was first reported to the World Health Organization (WHO) Country Office in China in December 2019 (1). Few months later, in March 2020, the WHO declared COVID-19 a pandemic (2). In Saudi Arabia, the first case of COVID-19 was confirmed on March 2, 2020. Due to the high contagiousness, rapid spread of the virus, severity of illness presentation, and lack of effective vaccine, the government of Saudi

Arabia had taken rigorous unprecedented precautionary measures to curb the spread of the disease, including declaring a national level “lockdown.” On March 23, 2020, the government of Saudi Arabia enforced local lockdown for 21 days, which was later extended up to 91 days. Lockdown measures included the mandatory closure of schools, travel restrictions, limiting the movement within and between all regions of the Kingdom, suspending commercial activities, self-quarantining, and implementing partial and a full-day curfew (3). As of June 21, 2020, the lockdown was completely lifted across the Kingdom (**Supplementary Figure 1**).

Despite the success of this action on containing the spread of the disease, it could have had a major impact on the mental health and well-being of people. Several studies were conducted concerning the psychological impact of COVID-19 in Saudi Arabia, most of them were carried out during the time of the lockdown. Majority of these studies indicated a moderate to severe psychological impact (4–7). These findings, in a way, echo those from previous studies conducted in different parts of the world (8–10). Furthermore, the psychological impact of COVID-19 was also investigated in different sub-populations, including healthcare workers. Since, the healthcare workers were facing a huge burden from the beginning of this crisis, which was emphasized by the WHO calling for actions to prevent serious consequences (11). In addition to stress of higher risk exposure due to the direct/indirect contact with infected patients, healthcare workers were also experiencing the restricted lockdown measures, social isolation, disrupted normal life activities, media information overload and panic. All these factors could be overwhelming, leading to a wide spectrum of serious psychological consequences. Several studies revealed that the healthcare workers could have a higher tendency to develop psychological problems compared to the general population (5, 7, 12, 13). Most of these studies were conducted during the lockdown period in many countries; yet, little is known about the impact of the lockdown and the temporal distribution of mental state of healthcare workers.

This study is the first to assess the mental health outcomes and associated risk factors in healthcare workers at different stages of the pandemic in Saudi Arabia. Herein, we sought to assess the levels of anxiety and depression among healthcare workers during the time of the lockdown and after returning to “normalcy” in Saudi Arabia and to identify the factors that are associated with the worsening of these symptoms.

METHODS

Ethics Statement

The study was approved by the local Research Advisory Committee and Research Ethics Committee of King Faisal Specialist Hospital and Research Centre-Jeddah (KFSHRC-J).

Study Design, Participants, and Procedure

This is a cross-sectional, survey-based study. Healthcare workers who were working in Saudi Arabia during the time of the study were invited to fill out the online surveys. On-line consents were obtained from the participants. Participants were allowed

to terminate the survey at any time they wished. Participants who were undertraining, observership, volunteering, or were outside the kingdom were excluded from the study. Since the primary outcome of the study was to examine the levels of anxiety and depression among healthcare workers during and after lifting of the lockdown in Saudi Arabia, the survey was distributed at two time points. The first survey was circulated in May 2020. During this period, the total confirmed cases of COVID-19 exceeded 86,000 in Saudi Arabia; therefore, in order to tackle the rapid rise of cases, a nationwide lockdown (between 11 and 24-h) was implemented. The second survey was circulated in August 2020, 8 weeks after lifting of the lockdown restrictions and returning to “normalcy” in all cities around the kingdom (**Supplementary Figure 1**).

Surveys were distributed using social media platforms, internal e-mails, and/or e-mails by the Saudi Commission for Health Specialties (SCFHS) to a randomly selected group of registered practitioners together with a snowball recruiting technique. This allowed us to obtain an adequate sample from different regions in a wide variety of health specialties. The self-administered surveys took 10 min to complete and were available in Arabic and English languages.

Measurements

The surveys included basic sociodemographic information including the participant's age, gender, marital status, income, nationality, education level and work status. Information regarding their direct exposure to COVID-19 patients, working in a COVID-19 designated site, being COVID-19 positive themselves or having a family member who is/was diagnosed with COVID-19 were also collected. Participants were also asked whether they were diagnosed for psychiatric disorders and/or chronic diseases in addition to their perception regarding their physical and mental health status compared to the time before the outbreak.

Anxiety and depressive symptoms were assessed via Generalized Anxiety Disorder (GAD-7) and Patient Health Questionnaire-9 (PHQ-9) scales; respectively. GAD-7 is a seven-item questionnaire and is most frequently used to measure, diagnose, and assess the severity of generalized anxiety disorder (GAD). The total scores—ranged from 0 to 21 - are interpreted as follows: no or minimal (0–4), mild (5–9), moderate (10–14), and severe (15–21) anxiety (14). PHQ-9 is a nine-item scale that is most commonly used for screening and diagnosing depression. PHQ-9 total scores—range from 0 to 27 - are interpreted as follows: normal (0–4), mild (5–9), moderate (10–14), moderately severe (15–19), and severe (20–27) depression (15). The threshold score of 10 for both scales has been shown to be a reasonable cutoff point for identifying cases of GAD and major depression (16, 17). Participants who had scores greater than the cutoff threshold were characterized as having severe symptoms.

Statistical Analysis

Data analysis was performed using R Studio software; R Core Team (2019), R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <http://www.R-project.org/>. We used the mean,

standard deviation and range to describe numeric variables, proportions and odds ratio to describe categorical variables. We also used student *t*-test, ANOVA and chi-Square inferential statistical analysis. Furthermore, we constructed multiple linear regression analysis models to predict the change in anxiety and depression scale through the different stages of lockdown, using GAD-7 and PHQ-9 scores as the dependent variables for each model separately, and phases of lockdown as the independent variables. The 95% confidence interval was determined, and the *p*-values were interpreted according to the American Statistical Association guidelines (18).

RESULTS

Demographic Characteristics

A total of 947 healthcare workers who responded to two independent surveys were included in the analysis. The majority of the participants were females (53.3%), aged between 20 and 70 years (37 ± 8.9), living in Jeddah (37%), followed by Riyadh (20%) (**Supplementary Figure 2**), earning between 10,000 and 29,999 SAR/month (61.5%), married (66.5%), and had a tertiary level of education (80.6%). Saudi nationals accounted for 78 % of the participants. Three hundred and seventy-eight of the participants were allied healthcare professionals (AHPs) (39.8%), 192 nurses (20.2%), 171 physicians (18%), 113 medical trainees (12%), 46 dentists (4.8%), and 47 pharmacists (5%). Among these participants, 246 (25.9%) reported working in high-risk areas (i.e., working in emergency rooms, intensive care units, and/or isolation wards). A total of 359 participants (40%) reported to have direct contact with COVID-19 cases during the study, but only 49 participants (5%) were diagnosed with COVID-19. About one fourth of the participants ($n = 250$) reported living with elderly. Sixty-nine participants (7%) reported a current or a pre-existing psychiatric diagnosis, including anxiety and depression, and 21.6% reported to have a chronic disease.

The demographic characteristics of the responders of each survey are shown in **Table 1**. Out of the 947 healthcare workers who participated in the study, 553 had responded to the first survey (during the lockdown) and 392 had responded to the second survey (after lifting the lockdown). The majority of the responders to the first and the second surveys were females (53.5% and 53.6%, respectively, $p = 0.9$), did not report a current or a pre-existing psychiatric diagnosis (93 % and 92.2%, $p = 0.64$) or chronic diseases (59.2% and 40.8%, $p = 0.96$). However, non-Saudis composed 38% of the responders to the second survey and only 9.6% in the first survey ($p < 0.001$). The marital status of the responders to the first and the second surveys was also different where 33% of the first-survey responders were married and 62.9% were single compared to 23.5 and 71.9%; respectively, among the second-survey responders ($p = 0.006$). Further, rate of positive COVID-19 infection was higher among the second-survey responders (8.41%).

Prevalence of Anxiety and Depression

The prevalence of severe anxiety, defined by GAD-7 total score of ≥ 10 , among the entire study participants was 23.3%. The proportions of mild, moderate, and severe anxiety during the

lockdown were 49.7, 40.9, and 9.4%; respectively, compared to the proportion after lifting of the lockdown 62.5, 21.2, and 16.3% ($\chi^2 = 43.2$, $df = 1$, $p < 0.001$). Severe anxiety (i.e., with threshold score of 10 or more) was more prevalent during the lockdown compared to the period when lockdown was lifted (25.9 vs. 19.6%, $p = 0.02$).

The prevalence of severe depression, defined by PHQ-9 total score of ≥ 10 , was 27%. The proportions of minimal, mild, moderate, moderately severe, and severe depression were 38, 33.3, 13.9, 9.2, and 5.6% respectively, compared to the proportion after lifting of the lockdown 51.3, 24.8, 12.4, 5.6, and 5.9% ($\chi^2 = 16.4$, $df = 4$, $p = 0.002$). There was no difference in the distribution of severe depression (i.e., with threshold score of 10 or more) during and after lockdown (28.6 vs. 23.8%, $p = 0.13$).

Association Between Demographic Characteristics and Levels of Anxiety & Depression

The average GAD-7 score across the participants during the two phases of the study was (6 ± 5.3); yet it was significantly higher during the lockdown (6.7 ± 5.4 vs. 5.1 ± 5.3 , $p < 0.001$, 95% CI; 0.8, 2.2). These scores tended to be influenced by the participants' demographic characteristics. **Table 2** summarizes the change in GAD-7 score during and after lockdown according to participants' characteristics. Women, participants with previous/current diagnosis of psychiatric disorders, working in COVID-19 designated sites, being in contact with COVID-19 patients, and those who were instructed to quarantine/isolate themselves demonstrated higher scores of GAD-7 during ($p = 0.003$, $p = < 0.001$, $p = 0.005$, $p < 0.001$, and $p = 0.001$) and after lockdown ($p = 0.04$, $p < 0.001$, $p = 0.014$, $p = 0.04$ and $p < 0.001$) respectively. Those who suffer from chronic diseases, working in high-risk areas (i.e., ER, ICU, and/or isolation wards), and those who were involved in the active screening process showed high levels of anxiety during the lockdown period ($p = 0.001$, $p < 0.001$, $p < 0.001$, respectively); but not after lifting of the lockdown (all $p > 0.05$). On the other hand, Saudi nationals and those living with elderly were more anxious after lifting of the lockdown ($p < 0.001$). Surprisingly, the level of anxiety did not differ significantly between those who were infected with COVID-19 and those who were not in both phases ($p > 0.05$); nevertheless, it was higher among the ones who reported having an infected family member during and after the lockdown ($p = 0.004$, $p = 0.057$ respectively). The impact on the anxiety level has also shown to vary based on the participants' occupation during and after the lockdown ($F_{5,549} = 3.4$, $p = 0.004$; $F_{5,386} = 3.58$, $p = 0.004$, respectively). *Post-hoc* comparisons using Tukey HSD test indicated that during the lockdown, the mean GAD-7 score for nurses (8.22 ± 6.33) was significantly different than the mean score of physicians and AHP ($p = 0.005$, $p = 0.018$). Although the level of anxiety among nurses was reduced after lifting of the lockdown, *post-hoc* comparisons indicated a trend toward significant differences between nurses and physicians ($p = 0.056$) (**Table 2**). A significant difference for the GAD-7 mean score between medical trainees and physicians was

TABLE 1 | Demographic and clinical characteristics of the participants.

	Total sample (<i>n</i> = 947)	During lockdown (<i>n</i> = 553)	After lockdown (<i>n</i> = 392)	<i>P</i> -value and statistics
Gender N (%)				
Male	439 (46.4%)	257 (46.5%)	180 (45.9%)	$\chi^2 = 0.009$, df = 1, <i>p</i> = 0.9
Female	506 (53.3%)	296 (53.5%)	210 (53.6%)	
Age (Mean ± SD)	36.87 ± 8.87	34.78 ± 7.6	39.9 ± 9.72	<i>F</i> _{1,941} = 0.81, <i>p</i> < 0.001
Nationality				
Saudis	740 (78%)	497 (90.4%)	243 (62.0%)	$\chi^2 = 109.34$, df = 1, <i>p</i> < 0.001
Non-Saudis	202 (21.3%)	53 (9.6%)	149 (38.0%)	
Monthly income				
<10,000 SAR	227 (24.2%)	99 (18.1%)	128 (32.7%)	$\chi^2 = 26.25$, df = 2, <i>p</i> < 0.001
10,000–29,999 SAR	584 (62.3%)	368 (67.4%)	216 (55.1%)	
30,000 SAR or more	127 (13.5%)	79 (14.5%)	48 (12.2%)	
Marital status				
Married	631 (66.5%)	183 (33.0%)	92 (23.5%)	$\chi^2 = 10.05$, df = 2, <i>p</i> = 0.006
Single	275 (29%)	349 (62.9%)	282 (71.9%)	
Divorced/separated	39 (4.1%)	22 (4.0%)	17 (4.3%)	
Education level				
Diploma	173 (18.2%)	124 (22.5%)	49 (12.7%)	$\chi^2 = 53.9$, df = 3, <i>p</i> < 0.001
Bachelor	425 (44.8%)	262 (47.6%)	163 (42.1%)	
Post-graduate degrees (MSc, PhD)	161 (17%)	55 (10%)	106 (27.4%)	
Advanced clinical training	178 (18.8%)	109 (19.8%)	69 (17.8%)	
History of/current psychiatric diagnosis				
Yes	69 (7%)	39 (7.0%)	30 (7.8%)	$\chi^2 = 0.216$, df = 1, <i>p</i> = 0.64
No	869 (91.6%)	516 (93.0%)	353 (92.2%)	
Chronic disease				
Yes	205 (21.6%)	121(21.8%)	84 (21.9%)	$\chi^2 = 0.002$, df = 1, <i>p</i> = 0.96
No	733 (77.2%)	434 (59.2%)	299 (40.8%)	
Living with elderly				
Yes	250 (26.3%)	167 (30.1%)	83 (21.2%)	$\chi^2 = 0.002$, df = 1, <i>p</i> = 0.96
No	697 (73.4%)	388 (69.9%)	309 (78.8%)	
Working in COVID-19 designated site				
Yes	452 (46.6%)	272 (49.0%)	180 (45.9%)	$\chi^2 = 9.40$, df = 1, <i>p</i> = 0.002
No	495 (52.2%)	283 (51.0%)	212 (54.1%)	
Infected with COVID-19				
Yes	49 (5.2%)	16 (2.89%)	33 (8.41%)	$\chi^2 = 14.34$, df = 1, <i>p</i> < 0.001
No	898 (94.6%)	539 (97.46%)	359 (91.5%)	

Bold values denote statistical significance at *p* < 0.05.

observed after the lockdown (*p* = 0.003). In addition, healthcare workers who perceived their physical and mental health status as being “worse/much worse” in comparison to the time before the outbreak showed a higher level of anxiety compared to the ones who thought that their health status did not change or became better (Table 2).

In terms of the scores during and after the lockdown for each group, an overall significant reduction was observed. For example, the total GAD-7 scores were significantly reduced for both men and women during and after the lockdown (*p* = 0.007, *p* = 0.002). A similar pattern of a consistent drop in GAD-7 score after lifting of lockdown was observed in all categories except

in participants with a pre-existing/current psychiatric disorder, those who were living with elderly, and those who were infected with COVID-19 (all *p* > 0.05). In addition, medical trainees, dentists, and pharmacists did not show a significant change in GAD-7 scores during the two phases. It was also observed that the mean anxiety score was reduced among non-Saudis after lifting of the lockdown.

Similar analyses were performed on PHQ-9 scale (Table 3). The average PHQ-9 score across the participants during the two phases of the study was 6.9 $\pm$ 6.24; yet it was significantly higher during the lockdown (7.4 $\pm$ 6.11 vs. 6.1 $\pm$ 6.4, *p* = 0.002). Similarly, women participants with mental illnesses,

TABLE 2 | Summary of the overall mean GAD-7 scores according to characteristics of the participants during and after lifting of the lockdown.

	Mean GAD scores					Mean GAD scores for severe anxiety (≥ 10)				
	During lockdown		After lockdown		p-value ^b	During lockdown		After lockdown		p-value ^b
	N	Mean (SD)	N	Mean (SD)		N	Mean (SD)	N	Mean (SD)	
Gender										
Male	257	5.9 (4.86)	180	4.58 (5.35)	0.007	58	13.3 (2.9)	28	15.1 (3.6)	0.012
Female	296	7.2 (5.68)	210	5.69 (5.28)	0.002	85	14.8 (3.5)	49	13.6 (3.3)	0.043
p-value ^a		0.003		0.04			0.004		0.06	
History of current psychiatric diagnosis										
Yes	39	9.9 (6.17)	30	9.4 (5.34)	0.69	22	14.5 (3.39)	15	13.7 (3.6)	0.52
No	516	6.4 (5.2)	353	4.79 (5.17)	<0.001	122	14.2 (3.4)	59	14.3 (3.4)	0.74
p-value ^a		<0.001		<0.001			0.70		0.5	
Chronic disease										
Yes	121	8.07 (5.85)	84	5.9 (5.37)	0.008	45	14.6 (3.3)	22	13.5(2.6)	0.18
No	434	6.26 (5.15)	299	4.9 (5.3)	<0.001	99	14.08 (3.40)	52	14.5 (3.7)	0.48
p-value ^a		0.001		0.10			0.39		0.29	
Working in COVID-19 designated site										
Yes	272	7.31 (5.45)	180	5.89 (5.71)	0.008	81	14.3 (3.3)	43	14.5 (3.5)	0.75
No	283	6.0 (5.2)	212	4.6 (4.91)	0.002	63	14.1 (3.4)	34	13.7 (3.3)	0.59
p-value ^a		0.005		0.014			0.7		0.32	
Living with elderly										
Yes	167	6.9 (5.5)	83	7.25 (6.24)	0.73	52	13.8 (3.3)	25	15.5 (3.5)	0.045
No	388	6.52 (5.3)	309	4.6 (4.9)	<0.001	92	14.4 (13.39)	52	13.5 (3.3)	0.11
p-value ^a		0.35		<0.001			0.26		0.018	
Infected with COVID-19										
Yes	16	7.25 (5.59)	33	4.9 (4.9)	0.153	5	3.6 (4.5)	9	12 (2.1)	0.48
No	539	6.64 (5.36)	359	5.1 (5.37)	<0.001	139	14.2 (3.3)	68	14.4 (3.5)	0.68
p-value ^a		0.65		0.81			0.66		0.04	
In contact with COVID-19 patients										
Yes	187	8.3 (5.77)	172	5.8 (5.4)	<0.001	70	14.5 (3.5)	38	14.3 (3.6)	0.83
No	368	5.8 (4.94)	220	4.6 (5.18)	0.008	74	13.9 (3.2)	39	13.9 (3.3)	0.98
p-value ^a		<0.001		0.04			0.30		0.5	
Nationality										
Saudi	497	6.63 (5.29)	243	6.03 (5.58)	0.161	130	14.08 (3.29)	59	14.4 (3.4)	0.45
Non-Saudi	53	7.13 (6.14)	149	3.77 (4.58)	<0.001	14	15.7 (4.02)	18	13.2 (3.4)	0.06
p-value ^a		0.51		<0.001			0.08		0.18	
Occupation										
Physician	94	5.57 (5.2)	77	3.38 (4.3)	0.003	17	14.7 (3.1)	5	15.6 (4.8)	0.65
Nurse	113	8.22 (6.33)	79	5.7 (5.3)	0.004	43	15.1 (3.6)	19	14 (2.8)	0.21
Medical trainee	71	7.32 (5.15)	42	7.14 (5.6)	0.86	24	13.2 (3.4)	14	13.7 (3.7)	0.65
Dentist	20	5.45 (5.56)	26	6.19 (6.3)	0.68	3	17 (3.6)	6	16.17 (2.6)	0.70
Pharmacist	27	6.26 (4.9)	20	6.20 (6.01)	0.9	5	14.6 (2.8)	5	15 (3)	0.83
Allied health care professional (AHP)	230	6.27 (4.8)	148	4.93 (5.16)	0.011	52	13.5 (3.06)	28	13.6 (3.7)	0.87
p-value ^a		0.004		0.004			0.07		0.5	
Working in high-risk area										
Yes	161	8.18 (5.78)	85	5.25 (5.47)	<0.001	59	14.5 (3.5)	17	14.2 (4.05)	0.79
No	394	6.03 (5.05)	307	5.15 (5.3)	0.026	85	14.02 (3.28)	60	14.15 (3.3)	0.82
p-value ^a		<0.001		0.88			0.35		0.8	
Confirmed cases among family members										
Yes	22	9.86 (6.48)	102	6.04 (5.64)	0.006	11	15.45 (2.8)	26	14.3 (3.8)	0.38
No	533	6.52 (5.27)	290	4.8 (5.19)	<0.001	133	14.14 (3.4)	51	14.1 (3.3)	0.96

(Continued)

TABLE 2 | Continued

	Mean GAD scores					Mean GAD scores for severe anxiety (≥ 10)				
	During lockdown		After lockdown		<i>p</i> -value ^b	During lockdown		After lockdown		<i>p</i> -value ^b
	<i>N</i>	Mean (SD)	<i>N</i>	Mean (SD)		<i>N</i>	Mean (SD)	<i>N</i>	Mean (SD)	
<i>p</i> -value ^a		0.004		0.057			0.2		0.8	
Experienced quarantine/isolation										
Yes	107	8.2 (5.9)	107	6.7 (5.7)	<0.001	37	15.1 (3.6)	33	14.1 (3.4)	0.25
No	448	6.29 (5.16)	285	4.5 (5.04)	<0.001	107	13.9 (3.2)	44	14.2 (3.5)	0.64
<i>p</i> -value ^a		0.001		<0.001			0.07		0.8	
Active screener										
Yes	51	9.18 (6.25)	52	4.3 (4.8)	<0.001	20	15.9 (3.5)	7	13.8 (3.6)	0.20
No	500	6.41 (5.19)	340	5.3 (5.3)	0.003	123	13.9 (3.3)	70	14.2 (3.4)	0.62
<i>p</i> -value ^a		<0.001		0.22			0.018		0.7	
Perceived physical health										
Almost not changed	305	5.2 (4.68)	172	3.5 (4.07)	<0.001	45	14.1 (3.6)	17	12.7 (2.8)	0.11
Better	92	6.58 (5.65)	52	3.38 (4.4)	<0.001	25	14.3 (3.7)	5	14.2 (3.6)	0.9
Worse	133	8.84 (5.2)	67	8.21 (5.3)	0.421	55	14.09 (3.03)	26	13.9 (3.1)	0.86
Much Worse	25	12.7 (4.97)	15	13.27 (5.2)	0.743	19	14.7 (3.4)	12	15.08 (3.9)	0.79
<i>p</i> -value ^a		<0.001		<0.001			0.9		0.3	
Perceived mental health										
Almost not changed	222	4.04 (4.1)	142	2.6 (3.3)	0.001	18	14.6 (3.7)	8	12.2 (2.7)	0.11
better	88	6.26 (5.66)	54	3.02 (4.38)	<0.001	23	14.1 (3.9)	4	15.2 (4.5)	0.62
Worse	187	8.07 (4.65)	86	7.83 (4.64)	0.681	58	13.8 (3.1)	29	13.34 (2.8)	0.49
Much worse	58	12.7 (4.85)	24	13.25 (4.8)	0.647	45	14.6 (3.2)	19	15.05 (3.6)	0.66
<i>p</i> -value ^a		<0.001		<0.001			0.6		0.11	

Bold values denote statistical significance at $p < 0.05$. *p*-value^a describes the statistical difference between groups within the same lockdown period (e.g., males vs. females). *p*-value^b describes the statistical difference within the same group but at different time points (e.g., males before vs. after lockdown).

and in contact with COVID-19 patients, who perceived their physical and mental health as “worse/much worse” were likely to demonstrate significantly higher scores on PhQ-9 during (all $p < 0.001$) and after lockdown ($p = 0.02$, $p < 0.001$, $p = 0.002$, $p < 0.001$) respectively. Also, PHQ-9 score was shown to differ based on the participants’ occupation during and after the lockdown ($F_{5,549} = 3.7$, $p = 0.002$; $F_{5,300} = 6.5$, $p < 0.001$, respectively), where nurses and medical trainees expressed the highest scores. *Post-hoc* comparisons indicated that, during the lockdown, the mean PHQ-9 score for nurses was significantly different than AHP ($p = 0.034$) and marginally different than physicians ($p = 0.056$). Significant differences were also observed between medical trainees and physicians ($p = 0.043$) and AHP ($p = 0.032$). Level of depression was reduced among nurses after the lockdown but not for medical trainees.

On the contrary for GAD-7 findings, working in COVID-19 designated sites, in high-risk areas, being an active screener and having an infected family member ($p = 0.034$, $p < 0.001$, $p = 0.029$, $p = 0.04$) were associated with higher total PHQ-9 scores but only during the lockdown. Saudis and participants who were asked to isolate themselves showed higher level of depression after lifting of lockdown ($p < 0.001$). In terms of changes in the scores within the groups during and after the lockdown, an overall significant reduction was observed

except for some groups. Similar to GAD-7 scale, the mean score for PHQ-9 also did not change significantly after lifting of the lockdown among medical trainees, dentists, pharmacists, participants with a psychiatric diagnosis or chronic diseases, the ones who were infected with COVID-19, or who were not working in high-risk areas (all $p > 0.05$) (Table 3). Interestingly, these findings were not observed among the surveys’ respondents when the analysis was restricted to participants with severe anxiety and depression.

Predictors of Anxiety and Depression During and After Lockdown

A linear regression analysis was conducted to assess whether the sociodemographic characteristics and the variables were related to the COVID-19 outbreak and could be significant predictors for the psychological outcomes (the GAD-7 and PHQ-9 scores). The “Enter” variable selection method was chosen for the linear regression model, which included all the selected predictors. Assumptions of homoscedasticity and multicollinearity were met and all predictors in the regression model presented a tolerance of more than 0.1 and VIFs <10 . The results of the linear regression model, for GAD-7, were significant ($F_{25,921} = 21.3$, $p < 0.001$, $R^2 = 0.37$, adjusted $R^2 = 0.35$), indicating that approximately 37% of the variance in the level of anxiety could be explained by the studied factors. Lockdown status, gender,

TABLE 3 | Summary of the overall mean PHQ-9 scores according to characteristics of the participants during and after lifting of the lockdown.

	Mean PHQ-9 scores					Mean PHQ-9 scores for severe anxiety (≥ 10)				
	During lockdown		After lockdown		p-value ^b	During lockdown		After lockdown		p-value ^b
	N	Mean (SD)	N	Mean (SD)		N	Mean (SD)	N	Mean (SD)	
Gender										
Male	257	6.3 (5.8)	146	5.2 (6.2)	0.09	64	14.8 (4.2)	26	16.4 (5.4)	0.14
Female	296	8.5 (6.07)	159	6.9 (6.4)	0.011	94	15.8 (4.4)	47	14.9 (4.8)	0.30
p-value ^a		< 0.001		0.02			0.12		0.22	
History of current psychiatric diagnosis										
Yes	39	13.2 (7.6)	25	13.16 (8.4)	0.96	24	18.3 (4.6)	16	18 (6.1)	0.85
No	516	7.03 (5.7)	247	5.4 (5.7)	<0.001	135	14.9 (4.1)	56	14.6 (4.4)	0.71
p-value ^a		<0.001		<0.001			<0.001		0.018	
Chronic disease										
Yes	121	8.2 (6.3)	64	6.7 (5.8)	0.09	41	15.5 (4.7)	20	14.1 (3.5)	0.17
No	434	7.2 (6.0)	235	5.9 (6.4)	0.008	118	15.3 (4.3)	52	15.8 (5.4)	0.54
p-value ^a		0.10		0.40			0.7		0.18	
Working in COVID-19 designated site										
Yes	272	8.03 (6.29)	137	6.7 (6.9)	0.06	87	15.6 (4.4)	39	15.8 (5.5)	0.88
No	283	6.93 (5.9)	169	5.5 (5.9)	0.014	72	15.10 (4.4)	34	15.09 (4.4)	0.9
p-value ^a		0.034		0.09			0.4		0.54	
Living with elderly										
Yes	167	8.4 (6.3)	67	7.9 (7.7)	0.57	57	15.7 (4.5)	21	17.8 (5.6)	0.09
No	388	7.0 (5.9)	239	5.5 (5.8)	0.002	102	15.2 (4.3)	52	14.5 (4.5)	0.35
p-value ^a		0.010		0.006			0.4		0.012	
Infected with COVID-19										
Yes	16	6.13 (5.4)	24	6.1 (7.1)	1.00	3	14 (6.08)	6	16.17 (7.02)	0.65
No	539	7.5 (6.13)	282	6.06 (6.3)	0.002	156	15.4 (4.4)	67	15.4 (4.9)	0.97
p-value ^a		0.37		0.9			0.5		0.73	
In contact with COVID-19 patients										
Yes	187	9.2 (6.8)	129	7.4 (7.05)	0.025	75	16.2 (4.5)	39	16.2 (5.5)	0.9
No	368	6.5 (5.4)	177	5.09 (5.6)	0.003	84	14.6 (4.2)	34	14.5 (4.3)	0.9
p-value ^a		<0.001		0.002			0.018		0.16	
Nationality										
Saudi	497	7.4 (6.0)	192	7.0 (6.7)	0.39	147	15.14 (4.2)	57	15.6 (5.2)	0.48
Non-Saudi	53	7.5 (7.1)	114	4.4 (5.2)	0.006	12	18.8 (5.1)	16	14.7 (4.3)	0.03
p-value ^a		0.9		0.001			0.005		0.5	
Occupation										
Physician	94	6.5 (6.2)	62	4.08 (4.34)	0.005	24	15.4 (4.6)	6	13.8 (3.6)	0.44
Nurse	113	8.8 (6.5)	63	6.8 (7.02)	0.06	37	16.7 (4.07)	17	16.2 (5.5)	0.72
Medical trainee	71	9.2 (6.3)	36	10.9 (8.01)	0.24	30	15.47 (4.3)	20	16.4 (6.4)	0.57
Dentist	20	6.4 (5.1)	20	5.10 (5.5)	0.42	4	14.7 (3.4)	4	14.5 (2.08)	0.90
Pharmacist	27	6.6 (5.6)	14	6.07 (6.3)	0.77	6	15.6 (2.5)	3	15.6 (6.02)	1.00
Allied health care professional (AHP)	230	6.8 (5.7)	111	5.3 (5.7)	0.025	58	14.5 (4.7)	23	14.7 (4.07)	0.88
p-value ^a		0.002		<0.001			0.31		0.8	
Working in high-risk area										
Yes	161	9.2 (6.6)	64	6.8 (7.1)	0.016	65	16.06 (4.4)	21	15.2 (5.7)	0.57
No	394	6.7 (5.7)	242	5.8 (6.1)	0.07	94	14.9 (4.3)	52	15.5 (4.8)	0.45
p-value ^a		<0.001		0.30			0.126		0.8	
Confirmed cases among family members										
Yes	22	10 (6.8)	76	7.2 (6.4)	0.08	10	15.6 (5.6)	27	14.2 (4.7)	0.47
No	533	7.3 (6.07)	230	5.6 (6.3)	<0.001	149	15.4 (4.3)	46	16.2 (5.1)	0.30
p-value ^a		0.04		0.07			0.8		0.11	

(Continued)

TABLE 3 | Continued

	Mean PHQ-9 scores					Mean PHQ-9 scores for severe anxiety (≥ 10)				
	During lockdown		After lockdown		<i>p</i> -value ^b	During lockdown		After lockdown		<i>p</i> -value ^b
	<i>N</i>	Mean (SD)	<i>N</i>	Mean (SD)		<i>N</i>	Mean (SD)	<i>N</i>	Mean (SD)	
Experienced quarantine/isolation										
Yes	107	8.4 (6.3)	83	7.9 (7.1)	0.61	38	15.5 (4.3)	31	15.5 (5.6)	0.88
No	448	7.2 (6.04)	223	5.3 (5.9)	<0.001	121	15.3 (4.4)	42	15.4 (4.7)	0.92
<i>p</i> -value ^a		0.06		0.001			0.8		0.9	
Active screening										
Yes	51	9.2 (7.5)	42	5.8 (6.7)	0.026	20	17.3 (4.8)	9	16.3 (6.2)	0.65
No	500	7.3 (5.9)	264	6.1 (6.3)	0.009	139	15.1 (4.3)	64	15.3 (4.9)	0.75
<i>p</i> -value ^a		0.029		0.8			0.04		0.5	
Perceived physical health										
Almost not changed	305	5.7 (5.1)	172	4.2 (4.5)	0.002	52	14.7 (4.2)	21	13.2 (4.1)	0.19
Better	92	6.6 (6.1)	52	3.4 (5.1)	0.002	26	14.6 (4.6)	5	16.4 (4.3)	0.43
Worse	133	10.4 (5.8)	67	10.10 (6.2)	0.67	59	15.7 (4.4)	34	15.1 (4.2)	0.66
Much worse	25	15.8 (5.2)	15	7.3 (18.07)	0.31	22	17.05 (4.3)	13	19.6 (6.5)	0.22
<i>p</i> -value ^a		<0.001		<0.001			0.13		0.003	
Perceived mental health										
Almost not changed	22	4.6 (4.6)	142	3.5 (3.9)	0.019	26	14.3 (4.6)	15	11.9 (2.8)	0.048
Better	88	6.4 (6.3)	54	3.1 (4.1)	<0.001	20	15.9 (4.7)	2	16.5 (7.7)	0.88
Worse	187	8.8 (5.0)	86	9.09 (6.38)	0.78	65	14.4 (4.0)	36	15.2 (4.4)	0.33
Much worse	58	15.12 (5.9)	24	16.63 (6.69)	0.31	48	17.1 (4.2)	20	18.4 (5.7)	0.36
<i>p</i> -value ^a		<0.001		<0.001			0.006		0.002	

Bold values denote statistical significance at $p < 0.05$. *p*-value^a describes the statistical difference between groups within the same lockdown period (e.g., males vs. females). *p*-value^b describes the statistical difference within the same group but at different time points (e.g., males during vs. after lockdown).

occupation, psychiatric diagnosis, chronic diseases, experiencing quarantine/self-isolation, the perceived physical and mental health status were found to be the factors to influence anxiety among healthcare workers. A significant drop in GAD-7 scores (1.2 points less, $p < 0.001$, 95 % CI; 0.54, 1.92) was noticed when the lockdown was lifted. Females, participants with psychiatric diagnosis and chronic diseases, nurses, participants who experienced quarantine or self-isolation, and who perceived their physical and mental health as much worse compared to the time before the pandemic showed higher level of psychological anxiety (Table 4A).

Interestingly, these predictors tend to vary based on the time of the pandemic. Gender, suffering from chronic diseases, working in high-risk areas, having an infected family member, being involved in active screening, and perceiving physical health as worse/much worse, have shown to be significant predictors for anxiety only during the time of the lockdown. On the other hand, working in COVID-19 designated sites, living with elderly, not infected with COVID-19, experiencing quarantine/isolation were significant predictors after lifting of the lockdown. Perceiving mental health status as worse/much worse was shown to be a predictor during both phases (Table 4A).

With respect to the depression scores, the results of the linear regression model were also significant ($F_{24,836} = 28.7$, $p < 0.001$, $R^2 = 0.45$, adjusted $R^2 = 0.43$), indicating that approximately 45% of the variance in the level of depression was explainable

by the studied factors. Similar to GAD-7, a significant drop in PHQ-9 scores (0.94 points less, $p = 0.014$, 95 % CI; 0.19, 1.7) was detected when the lockdown was lifted. Further, females, participants with psychiatric diagnosis, living with elderly, being in contact with COVID-19 cases, working in high-risk areas, and the ones who perceived their physical and mental health as “worse/much worse” compared to the time before the pandemic showed higher level of psychological depression (Table 4B). Most of these predictors, i.e., gender, psychiatric diagnosis, being in contact with COVID-19 patients, and perceived physical and mental health tend to be significant regardless of the phase of the lockdown. Living with elderly and working in high-risk areas were significant predictors for depression but only during the lockdown (Table 4B).

DISCUSSION

The current study sought to measure the magnitude of depression and anxiety during and after the lockdown restrictions among healthcare professionals across different healthcare settings in Saudi Arabia. It also examined whether some individuals could be more adversely affected by the COVID-19 pandemic than others by looking at the association between different demographic characteristics and the psychological impact.

TABLE 4A | A. Regression coefficients for Generalized Anxiety Disorder-7 (GAD-7) as an outcome with socio-demographic and COVID-19 related variables as predictors.

	GAD-7 ($R^2 = 0.37$)					GAD-7—During Lockdown ($R^2 = 0.36$)					GAD-7—After Lockdown ($R^2 = 0.41$)				
	β	SEM	t value	p-value	95% CI	β	SEM	t value	p-value	95% CI	β	SEM	t value	p-value	95% CI
Lockdown status															
During lockdown	1.234	0.351	3.517	<0.001	0.54, 1.92										
After lockdown			Reference												
Gender															
Male	−0.81	0.299	−2.738	0.006	−1.40, −0.23	−0.879	0.394	−2.232	0.026	−1.65, −0.1	−0.693	0.468	−1.480	0.140	−1.61, 0.22
Female			Reference					Reference					Reference		
History of current psychiatric diagnosis															
Yes	2.585	0.564	4.586	<0.001	1.47, 3.69	2.83	0.753	3.763	<0.001	1.35, 4.31	1.627	0.889	1.831	0.068	−0.12, 3.37
No			Reference					Reference					Reference		
Chronic disease															
Yes	1.050	0.350	3.004	0.003	0.36, 1.73	1.395	0.457	3.055	0.002	0.49, 2.29	0.425	0.545	0.780	0.436	−0.64, 1.49
No			Reference					Reference					Reference		
Working in COVID-19 designated site															
Yes	0.292	0.328	0.891	0.373	−0.35, 0.93	−0.19	0.437	−0.445	0.657	−1.05, 0.66	0.990	0.502	1.972	0.049	0.003, 1.97
No			Reference					Reference					Reference		
Living with elderly															
Yes	0.476	0.339	1.404	0.161	−0.18, 1.14	0.082	0.424	0.193	0.847	−0.75, 0.91	1.313	0.577	2.274	0.024	0.17, 2.44
No			Reference					Reference					Reference		
Infected with COVID-19															
Yes	−1.25	0.726	−1.724	0.085	−2.67, 0.17	0.168	1.192	0.141	0.888	−2.17, 2.5	−1.859	0.930	−1.999	0.046	−3.68, −0.03
No			Reference					Reference					Reference		
In contact with COVID-19 patients															
Yes	0.584	0.356	1.641	0.101	−0.11, 1.28	0.861	0.484	1.779	0.076	−0.09, 1.81	0.065	0.538	0.122	0.903	−0.99, 1.12
No			Reference					Reference					Reference		
Nationality															
Saudi	0.652	0.414	1.575	0.115	−0.16, 1.46	0.527	0.691	0.762	0.446	−0.83, 1.88	0.841	0.519	1.621	0.106	−0.17, 1.86
Non-Saudi			Reference					Reference					Reference		

(Continued)

TABLE 4A | Continued

	GAD-7 ($R^2 = 0.37$)					GAD-7—During Lockdown ($R^2 = 0.36$)					GAD-7—After Lockdown ($R^2 = 0.41$)				
	β	SEM	t value	p-value	95% CI	β	SEM	t value	p-value	95% CI	β	SEM	t value	p-value	95% CI
Occupation															
Physician	−1.22	0.419	−2.925	0.004	−2.04, −0.40	−1.28	0.550	−2.336	0.020	−2.36, −0.2	−0.909	0.647	−1.404	0.161	−2.18, 0.36
Nurse	0.855	0.421	2.031	0.043	0.02, 1.68	0.685	0.550	1.247	0.213	−0.39, 1.76	0.940	0.655	1.435	0.152	−0.34, 2.22
Medical trainee	−0.60	0.487	−1.237	0.216	−1.56, 0.35	−0.95	0.619	−1.543	0.123	−2.17, 0.26	−0.398	0.801	−0.497	0.620	−1.97, 1.17
Dentist	0.495	0.691	0.716	0.474	−0.86, 1.85	−1.22	1.038	−1.176	0.240	−3.25, 0.81	1.750	0.927	1.887	0.060	−0.07, 3.57
Pharmacist	0.969	0.679	1.426	0.154	−0.36, 2.30	0.474	0.892	0.531	0.596	−1.27, 2.22	1.455	1.043	1.394	0.164	−0.59, 3.50
AHP	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Working in high-risk area															
Yes	0.589	0.370	1.593	0.112	−0.13, 1.31	1.08	0.472	2.289	0.022	0.15, 2.0	0.174	0.603	0.289	0.773	−1.01, 1.36
No			Reference					Reference					Reference		
Family member infected with COVID-19															
Yes	0.764	0.472	1.618	0.106	−0.16, 1.69	2.15	0.976	2.209	0.028	0.23, 4.07	0.270	0.547	0.494	0.621	−0.80, 1.34
No			Reference					Reference					Reference		
Experienced quarantine/isolation															
Yes	1.040	0.397	2.623	0.009	0.26, 1.81	0.647	0.537	1.205	0.229	−0.40, 1.7	1.479	0.599	2.467	0.014	0.3, 2.65
No			Reference					Reference					Reference		
Active screening															
Yes	0.621	0.507	1.224	0.221	−0.37, 1.61	1.862	0.714	2.608	0.009	0.45, 3.26	−0.459	0.735	−0.625	0.532	−1.90, 0.98
No			Reference					Reference					Reference		
Perceived physical health															
Almost not changed	—	—	—	—	—	—	—	—	—	—	−2.911	0.599	−4.860	<0.001	−4.08, −1.73
Better	0.652	0.523	1.246	0.213	−0.37, 1.67	0.773	0.667	1.159	0.247	−0.53, 2.08	−2.520	0.983	−2.562	0.011	−4.45, −0.58
Worse	1.418	0.418	3.395	0.001	0.59, 2.23	1.20	0.520	2.306	0.021	0.17, 2.22	−0.841	0.855	−0.983	0.326	−2.52, 0.84
Much worse	2.577	0.847	3.041	0.002	0.91, 4.24	2.45	1.104	2.225	0.027	0.28, 4.62	0.668	1.465	0.456	0.649	−2.21, 3.54
Perceived mental health															
Almost not changed	−2.77	0.564	−4.916	<0.001	−3.87, −1.66	—	—	—	—	—	—	—	—	—	—
Better	−2.00	0.729	−2.751	0.006	−3.43, −0.57	1.23	0.705	1.749	0.081	−0.15, 2.62	−0.055	0.850	−0.065	0.948	−1.72, 1.61
Worse	0.742	0.624	1.190	0.235	−0.48, 1.96	3.37	0.489	6.904	<0.001	2.41, 4.33	3.675	0.659	5.575	<0.001	2.37, 4.97
Much worse	4.040	0.822	4.917	<0.001	2.42, 5.65	6.43	0.808	7.965	<0.001	4.85, 8.02	7.030	1.150	6.115	<0.001	4.76, 9.29

Bold values denote statistical significance at $p < 0.05$.

TABLE 4B | B. Regression coefficients for Patient Health Questionnaire-9 (PHQ-9) as an outcome with socio-demographic and COVID-19 related variables as predictors.

	PHQ-9 ($R^2 = 0.45$)					PHQ-9-during lockdown ($R^2 = 0.36$)					PHQ-9-after lockdown ($R^2 = 0.41$)				
	β	SEM	t value	p-value	95% CI	β	SEM	t value	p-value	95% CI	β	SEM	t value	p-value	95% CI
Lockdown status															
During lockdown	0.948	0.383	2.473	0.014	0.19, 1.7										
After lockdown			Reference												
Gender															
Male	-1.514	0.339	-4.470	<0.001	-2.17, -0.84	-1.64	0.431	-3.813	<0.001	-2.49, -0.79	-1.34	0.581	-2.313	0.021	-2.48, -0.2
Female			Reference					Reference					Reference		
History of current psychiatric diagnosis															
Yes	4.555	0.634	7.186	<0.001	3.31, 5.79	5.103	0.825	6.182	<0.001	3.48, 6.72	3.031	1.094	2.772	0.006	0.87, 5.184
No			Reference					Reference					Reference		
Chronic disease															
Yes	0.044	0.396	0.110	0.912	-0.73, 0.82	0.341	0.500	0.683	0.495	-0.64, 1.32	-0.603	0.674	-0.894	0.372	-1.93, 0.72
No			Reference					Reference					Reference		
Working in COVID-19 designated site															
Yes	-0.442	0.372	-1.187	0.236	-1.17, 0.28	-0.540	0.479	-1.128	0.260	-1.48, 0.4	-0.270	0.613	-0.44	0.66	-1.47, 0.93
No			Reference					Reference					Reference		
Living with elderly															
Yes	0.767	0.379	2.025	0.043	0.02, 1.51	0.976	0.464	2.103	0.036	0.06, 1.88	0.413	0.693	0.596	0.552	-0.95, 1.77
No			Reference					Reference					Reference		
Infected with COVID-19															
Yes	-1.37	0.857	-1.605	0.109	-3.05, 0.30	-1.21	1.30	-0.929	0.353	-3.78, 1.35	-1.68	1.162	-1.453	0.147	-3.97, 0.59
No			Reference					Reference					Reference		
In contact with COVID-19 patients															
Yes	1.243	0.408	3.048	0.002	0.44, 2.04	1.050	0.530	1.979	0.048	0.008, 2.09	1.54	0.674	2.298	0.022	0.22, 2.87
No			Reference					Reference					Reference		
Nationality															
Saudi	0.524	0.478	1.095	0.274	-0.41, 1.46	0.268	0.757	0.354	0.723	-1.21, 1.75	0.733	0.624	1.176	0.241	-0.49, 1.96
Non-Saudi			Reference					Reference					Reference		

(Continued)

TABLE 4B | Continued

	PHQ-9 ($R^2 = 0.45$)					PHQ-9-during lockdown ($R^2 = 0.36$)					PHQ-9-after lockdown ($R^2 = 0.41$)				
	β	SEM	t value	p-value	95% CI	β	SEM	t value	p-value	95% CI	β	SEM	t value	p-value	95% CI
Occupation															
Physician	-0.930	0.474	-1.964	0.050	-1.85, 0	-0.874	0.603	-1.450	0.148	-2.05, 0.31	-0.823	0.794	-1.036	0.301	-2.38, 0.74
Nurse	0.850	0.474	1.793	0.073	-0.08, 1.78	0.710	0.602	1.179	0.239	-0.47, 1.89	0.891	0.792	1.125	0.261	-0.66, 2.44
Medical trainee	0.658	0.545	1.208	0.227	-0.41, 1.72	0.069	0.678	0.101	0.919	-1.26, 1.40	1.713	0.967	1.771	0.078	-0.19, 3.61
Dentist	-0.454	0.801	-0.567	0.571	-2.02, 1.11	-1.09	1.137	-0.966	0.335	-3.33, 1.13	0.348	1.151	0.302	0.763	-1.91, 2.61
Pharmacist	0.422	0.780	0.541	0.589	-1.10, 1.95	0.077	0.978	0.078	0.938	-1.84, 1.99	0.641	1.324	0.484	0.629	-1.96, 3.24
AHP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Working in high-risk area															
Yes	1.01	0.42	2.420	0.016	0.19, 1.84	1.34	0.517	2.604	0.009	0.33, 2.36	0.551	0.763	0.722	0.471	-0.95, 2.05
No			Reference					Reference					Reference		
Family member infected with COVID-19															
Yes	0.680	0.563	1.209	0.227	-0.42, 1.78	1.370	1.069	1.281	0.201	-0.73, 3.47	0.187	0.676	0.277	0.782	-1.14, 1.51
No			Reference							Reference					
Experienced quarantine/isolation															
Yes	0.13	0.44	0.298	0.766	-0.74, 1.01	-0.095	0.588	-0.161	0.872	-1.25, 1.06	0.700	0.724	0.967	0.334	-0.72, 2.12
No			Reference					Reference					Reference		
Active screening															
Yes	0.76	0.57	1.333	0.183	-0.36, 1.88	1.21	0.782	1.559	0.120	-0.31, 2.75	0.425	0.888	0.479	0.633	-1.32, 2.17
No			Reference					Reference					Reference		
Perceived physical health															
Almost not changed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Better	0.387	0.564	0.686	0.493	-0.72, 1.49	0.487	0.731	0.665	0.506	-0.95, 1.92	0.383	0.918	0.417	0.677	-1.42, 2.19
Worse	2.701	0.451	5.995	<0.001	1.81, 3.58	2.370	0.570	4.159	<0.001	1.25, 3.48	3.155	0.756	4.172	<0.001	1.66, 4.64
Much worse	5.278	0.913	5.778	<0.001	3.48, 7.07	5.006	1.21	4.138	<0.001	2.6, 7.38	6.105	1.480	4.126	<0.001	3.19, 9.01
Perceived mental health															
Almost not changed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Better	0.307	0.584	0.525	0.600	-0.84, 1.45	0.884	0.773	1.144	0.253	-0.63, 2.40	-0.736	0.910	-0.809	0.419	-2.52, 1.05
Worse	3.201	0.422	7.583	<0.001	2.37, 4.03	3.041	0.536	5.679	<0.001	1.98, 4.09	3.576	0.707	5.059	<0.001	2.18, 4.96
Much worse	7.001	0.704	9.944	<0.001	5.61, 8.38	6.703	0.885	7.571	<0.001	4.96, 8.44	7.803	1.236	6.312	<0.001	5.37, 10.23

Bold values denote statistical significance at $p < 0.05$.

We observed a prevalence of significant depression and anxiety (27 and 23% respectively) among healthcare professionals. This is in line with a recent systematic review (19) which reported prevalence rates of 12.1–55.89% for depression and 24.1–67.55% for anxiety. For the regional comparison, the reported prevalence rates of depression and anxiety among healthcare professionals in Saudi Arabia ranged between 55.2 and 69% for depression and 31.5–58.9% for anxiety (20–24). The different methods used in various studies can explain the higher prevalence rates observed compared to the current study. Explanation of these high rates also include not accounting for the period after easing of the lockdown restrictions and assessing depression and anxiety during the first few months of the pandemic.

Across both periods of the lockdown, higher levels of depression and anxiety were found in women, who were at a greater risk of infection due to working in COVID-19 designated sites or in contact with COVID-19 patients, or working in high-risk places (ER, ICU, and/or isolated wards), had a current or a previous history of psychiatric disorder, were living with elderly and the ones who were instructed to quarantine/isolate themselves. Similar to our results, systematic reviews (19, 25, 26) and a meta-analysis (27) revealed higher depression and anxiety levels among female healthcare professionals and ones working in the areas with high rates of COVID-19 cases.

We noticed that the depression and anxiety levels were higher in medical trainees and nurses compared to other specialties. Nurses have consistently shown higher rates of depression and anxiety in systematic reviews, although medical trainees were not specifically targeted in the systematic reviews (19, 25, 26). Given the challenges faced by medical trainees during the pandemic such as limited patient contacts, non-campus activities, online assessment and exams, and restricted clinical rotations, significant stress and burnout were reported (28–30). In fact, longer professional experience has been reported as potentially protective factor to develop psychopathological distress in healthcare workers (31).

We did not detect significant differences between those who were infected with the virus and those who were not. On the contrary, the ones with family members who had been diagnosed with COVID-19 were more vulnerable to anxiety and depressive symptoms, owing to greater family burden and psychological impact. The concern of carrying the virus home and passing the infection to the family was shown to be an important stress-triggering factor among healthcare workers (32).

Healthcare workers who were asked to isolate themselves for showing mild symptoms or had close contact with infected persons, also showed higher levels of anxiety and depression. Those who experienced self-isolation could fear more from being infected and worry about the health risks to their own family. This anticipation shows that much of the psychological toll was already being experienced.

The mental health of people with underlying chronic diseases has been shown to be deteriorated, which could be due to the fact that they are at a heightened risk for severe COVID-19 symptoms and increased risk of contracting the disease (33). Similarly, those with current or pre-existing psychiatric conditions also

have elevated levels on both scales; which is consistent with previous studies (13). Although several factors have been shown to aggravate the psychological burden among healthcare workers, they do not seem to play a role among the severe cases. Yet, due to the small number of participants in some of the sub-groups, these results should be dealt with caution and need to be replicated in a larger sample.

Whether during the COVID-19 pandemic or before it, the prevalence of depression, anxiety and burnout has been consistently shown to be common among healthcare providers (34–36). However, the impact of the pandemic has made this worse for the healthcare professionals (37, 38). While the healthcare professionals already face the challenges of exposure risk to infection, role conflict (the professional and the family), demanding and changing work environment, uncertainty of the pandemic progress, isolation, and quarantine, the lockdown restrictions added further burden (37, 39). Mediated by social isolation, the sense of loneliness and its negative emotions can be aggravated (40, 41). This may lead to a downward vicious cycle of psychological events impacting negatively on the individual mental health including increased risk of suicide (42). On the other hand, easing the lockdown restrictions might result in improving the mental health. In the current study, we found a significant drop in the mean score of both PHQ-9 and GAD-7 after lifting of the lockdown restrictions among the healthcare workers when excluding those with a current or a pre-existing psychiatric disorder. A similar decrease in depression and anxiety was found both in the general population and healthcare workers in Wuhan, where the virus outbreak was first reported (1), after 2 months of easing the lockdown restrictions (43).

It is now obvious that the pandemic does not affect everyone equally. Regression analysis identified several predictors of anxiety and depression among healthcare workers in Saudi Arabia. Women, individuals with past or present psychiatric illnesses, nurses, individuals who experienced self-isolation, individuals living with elderly, those working in high-risk areas and individuals with physical and mental illness perception were negatively impacted.

Interestingly, these predictors varied between the two phases of the study which could be due to the rapidly changing and uncertain situation of the disease. During lockdown period, gender, psychiatric diagnosis and chronic diseases status, occupation, working areas, family infection, physical illness perception and mass screening were significant predictors for anxiety. Yet, after lifting of the lockdown, none of them remained significant. Mass active screening was also a significant predictor for anxiety during the lockdown only; however, after lifting the lockdown, this process became more structured and did not seem to have an independent effect on anxiety. After easing of lockdown restrictions, working in designated hospitals, living with elderly, and self-isolation were identified as significant predictors. In addition, participants' positive infection status and positive physical health perception could have a protective effect against anxiety. These results highlight the importance of studying the psychological impact while accounting for the phase of the pandemic. The impact as

well as the people who might be negatively affected could be changed from one phase to the other. It is worth mentioning that some symptoms could be more sensitive to these changes than others. In the present study, and on the contrary to what was observed with anxiety, predictors for depression seemed to be more consistent regardless the phase of the pandemic.

The current study has several strengths. First, it measured anxiety and depression in a representative sample with adequate sample size. Second, depression and anxiety were assessed using validated scales. Third, although the cross-sectional design of the study, the assessment was done at two periods of time, during and after easing of the lockdown restrictions. Nonetheless, the study is not without limitations. The cross-sectional design and the convenient sampling method limited the causality interpretations for the decreased depression and anxiety after easing of the lockdown restrictions. Further, recruiting participants through social media could introduce a selection bias by excluding those who don't have access to these platforms. Yet, we tried to overcome this by sending the surveys using internal emails. Also, by using the online anonymous recruitment methodology, there is possibility of the respondents completing the survey more than once, but we had used a conservative approach of removing suspected duplications. There is also a possibility that some had participated in both surveys, which could affect the results. However, it would be difficult to confirm this without having personally identifiable information of the participants. In addition, self-report instruments could introduce a systematic bias in comparison to interview-based measures; but under such restrictive measures opting for the latest is challenging. Also, the application of the lockdown restrictions was not the same across different regions of the country which could have affected the mental health of the healthcare workers differently. Not including the evaluation of posttraumatic stress and/or burnout that could represent a potential confounder for anxiety and depressive symptoms is another limitation in the current study. Psychological distress/burnout has shown to contribute to the development or the persistence of psychiatric complications in healthcare workers facing COVID-19 pandemic, particularly depressive and anxiety symptoms (44). Furthermore, despite the relatively large number of participants, they were not equally distributed between regions which could hinder the generalization of these findings due to limited representation.

In light of these findings, immediate actions need to be taken to address the psychological needs of the vulnerable groups of healthcare workers as the pandemic continues. Healthcare systems should enhance strategies to face this relevant issue in healthcare workers and longer-term strategic programs should be implemented. As the situation of the pandemic changes, the rates of anxiety, depression, and other psychological issues have to be monitored. In addition, individualized tailored interventions

that take into account the characteristics and socio-demographic variables of the affected individuals could be developed.

CONCLUSION

The COVID-19 pandemic was associated with high rates of depression and anxiety among healthcare workers worldwide and in Saudi Arabia. Although several factors could have impacted the mental health state of the healthcare workers, but the ease of the lockdown restrictions was significantly associated with decreased mean scores of the PHQ-9 and GAD-7 among healthcare workers in Saudi Arabia. In addition, future studies with larger sample sizes would be preferable to track the trajectories of mental health outcomes among healthcare workers, in order to define mental health interventions and to design mental health care programs to deal with and minimize these psychological issues.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because they contain information that could compromise the privacy of research participants. Requests to access the datasets should be directed to Dr. Hussain M. Khrad (hkhrad@hotmail.com).

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the local Research Advisory Committee and Research Ethics Committee of King Faisal Specialist Hospital and Research Centre-Jeddah (KFSHRC-J). The patients/participants provided their informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

HK, WF, and AA designed the study and wrote the protocol. FB and WF performed the statistical analyses. All the authors made a significant contribution to the interpretation of the data and drafting of the manuscript, revising it critically for intellectual content, and approved the final version of the manuscript.

ACKNOWLEDGMENTS

The authors are grateful to all the surveys respondents for their participation in this study.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2021.683603/full#supplementary-material>

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Mental Health in Residential Healthcare Workers During the COVID-19 Pandemic: The Moderating Role of Selfobject Needs

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Specialty section:

This article was submitted to
Mood Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 19 August 2020

Accepted: 29 September 2021

Published: 27 October 2021

Citation:

Arble EP, Shankar S, Steinert SW and Daugherty AM (2021) Mental Health in Residential Healthcare Workers During the COVID-19 Pandemic: The Moderating Role of Selfobject Needs. *Front. Psychiatry* 12:596618. doi: 10.3389/fpsy.2021.596618

The COVID-19 outbreak has affected healthcare across all levels. Older adults and those with chronic illness are at greatest risk for infection complications and mortality, which presents significant psychological distress for residential healthcare workers. The concept of selfobject needs, consisting of Mirroring, Idealizing, and Twinship, may be relevant in explaining psychological distress. This study seeks to enhance our understanding of the needs of healthcare workers responsible for elderly patients and evaluate the role of psychosocial support through selfobject needs to mitigate the effects of trauma during the pandemic. Participants ($N = 103$) employed in residential healthcare facilities in the metropolitan Detroit, MI (USA) region completed an online survey during the peak initial infection. Assessments included standardized measures of trauma-related symptoms, depression, anxiety, and general distress symptoms, as well as a validated measure of selfobject needs. Residential healthcare workers reported mental health symptoms across domains, including clinical elevations in symptoms of trauma, depression, and anxiety. Selfobject needs and mental health outcomes were positively correlated, indicating that greater unmet relational need was associated with greater severity of symptoms. Greater trauma symptom severity as a proxy index of current experience during the pandemic predicted high depressive symptoms, and greater Mirroring need worsened the effect. These results suggest that interventions targeting selfobject needs, specifically Mirroring, may be effective at mitigating acute mental health symptoms among healthcare workers during a distressing event.

Keywords: COVID-19, nursing home, post-traumatic stress disorder, depression, interpersonal functioning

INTRODUCTION

The emergence of the COVID-19 pandemic in the United States created a crisis across all levels of healthcare. In the initial infection waves, the crisis was defined by the rapid spread of the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), and the limitations of medical knowledge to treat and contain the illness at the time. In response to increasing patient demand, healthcare employees contended with extended work hours, fear for their own personal safety, anxiety for the safety of co-workers and loved ones, and ongoing exposure to the death and suffering of patients

(1, 2). These concerns were amplified in residential healthcare, consisting of nursing homes, assisted living communities, and in-home healthcare that provide long-term and post-acute recovery care for some of the highest-risk populations, including older adults and those with chronic medical conditions (1, 3). These challenges faced by providers within residential healthcare were compounded by insufficient staff, depleted supplies, transfer of new patients to these services, and patients whose physical and psychological welfare were deteriorating due to the crisis (4). Healthcare workers in these settings experienced primary and secondary trauma (5) with significant emotional consequences, including acute symptoms of post-traumatic stress disorder (PTSD), depression, and general distress (6, 7). Similar patterns were observed in the 2003 SARS-CoV-1 outbreak (8), where it was found that social isolation and attachment insecurity mediated the effects of trauma exposure on greater mental health symptom severity (9). The current study aimed to evaluate the role of selfobject needs, a personality construct that is reflective of the psychological need for interpersonal connection, in modifying anxiety and depression symptom severity related to trauma symptoms in residential healthcare workers during the COVID-19 pandemic.

While emotional distress and secondary trauma in palliative care is typical for residential healthcare workers (10, 11), the experience during the COVID-19 pandemic was expected to be more severe and also have new sources of distress. The increased exposure to grief and loss, the influx of new patients requiring post-acute recovery care, new safety procedures in place to mitigate transmission, and organizational shortages in necessary supplies were new and defining features of residential healthcare worker experiences during the COVID-19 pandemic (1). Furthermore, these challenges were exacerbated by the need for quarantine and social distancing outside of working hours, which can be reflected in feeling a lack of emotional support. The disruption of personal and professional support challenged trust in leadership across professional and social contexts, including concerns about lack of adequate training and material resources (12). At the time, activities permissible during time outside of work were to some extent controlled by government officials, further compounding concerns with organizational policies, broadly defined. In this sense, all healthcare workers were vulnerable to psychological distress during the COVID-19 pandemic and residential healthcare employees were uniquely experiencing an intersection of challenges with the chronically ill and elderly, with heightened isolation protocols.

The broad disruption to social and emotional support created a vulnerability for residential healthcare workers to develop poor mental health following the increase in stress and trauma during the pandemic. Developing a nuanced understanding of the experiences of healthcare workers, especially those in residential facilities that were strongly impacted by COVID-19, is crucial for informing policies to support their personal well-being. Development of clinical mental health disorders is not inevitable after traumatic experiences, and identifying factors that ameliorate acute symptoms may be useful to promote resiliency in the frontline healthcare workforce.

Selfobject needs, as proposed by Heinz Kohut's theory of self psychology (13–16), is one theoretical model that can account for the experience of distress and other psychological symptoms, as well as the relational and personality features that are predictive of healthcare workers' responses to distress and trauma. This theory has been employed in a variety of clinical contexts (17), has proven relevant for occupational functioning (18), contributes to emotional resilience (19), and can be reliably measured (20). In brief, the theory advanced by Kohut proposes that an individual's ability to navigate emotional challenges will in large part be dependent upon the extent to which they have had, and continue to have, specific relational needs met. In essence, an individual whose core relational needs are being met is able to develop and maintain a healthy sense of self, which encapsulates aspects of purpose, self-worth, and belonging. Conversely, individuals whose needs are not being met may experience a diminished sense of self, which can lead to a variety of clinical difficulties, as well as an inability to remain emotionally regulated in the face of internal and external challenges.

Kohut proposed the existence of three selfobject needs: Mirroring, Idealizing, and Twinship (13–16). Mirroring refers to receiving recognition for one's contributions and value. An in-home healthcare worker whose family members empathize with their struggles and praise them for their bravery and self-sacrifice may experience the sense of having their value being "mirrored." As the need for Mirroring reflects that people need to have their own value recognized, Kohut proposed that individuals also seek to connect themselves with others whose value they recognize. An individual who experiences someone in their life as admirable and worthy of emulation may experience the benefit of Idealizing. For example, a nurse who admires their supervisor's ability to maintain a sense of calm while capably performing their duties may feel that their connection with this supervisor enhances their own self-worth, and that nurse may derive a sense of striving and purpose as a result of this connection. Finally, the selfobject need of Twinship refers to experiencing a sense of belonging and participation, a recognition of oneself in someone else. For example, a social worker conversing with a colleague, seeing another person who truly understands their struggles and motivations, may experience a sense of connection and "alikehood." This experience could be understood as a feeling of Twinship.

According to Kohut, having these needs met over the course of development results in a healthy sense of self, a kind of self-cohesion that would allow the developing individual to withstand the emotional and relational challenges facing them in their life. However, a fundamental component of the self psychology articulated by Kohut was the premise that the need for selfobject responsiveness is never outgrown (14). People require the interaction of others to maintain their sense of self, and lack of such experiences can prove to be harmful at any stage of life. Much as the well-fed individual can comfortably miss a meal but nonetheless requires nourishment, an individual whose selfobject needs have historically been met is more likely to demonstrate emotional resilience, but is still vulnerable to their absence or insufficiency. Of particular relevance to the current pandemic, selfobject need increases in times of duress and

transition, such that even individuals with strong and positive relational histories may find themselves overwhelmed in the face of extraordinary demands and isolation (21).

The concept of selfobject needs has received theoretical and empirical consideration for some time (21, 22), with recent research highlighting its utility when considering the experience of potentially traumatic events (23, 24). Contemporary theorists and clinicians have continued to draw upon and elaborate on the selfobject concept, identifying new pathways for its use in both assessment and intervention (25, 26). It has been well-documented that the ability to draw upon social relationships is an important coping strategy that can effectively alter stress responses on an emotional and physiological level (27, 28). However, the ability to utilize relational resources may in part be dependent upon an individual's view of self (29, 30), and some social networks may be unable to provide the needed support, the lack of which may ultimately result in the development of symptoms such as loneliness and depression (31–33).

This sequence of encountering a difficult experience, followed by social disruption and intense negative emotions, fits well within the self psychology framework (34). In this understanding, trauma is conceptualized *via* the external event *and* the subjective and introspective meaning applied to the event (35). According to Kohut, the experience of a potentially traumatic event can provoke a rupture in selfobject connection, such that the individual no longer inhabits a world where they feel safe, understood, and valued (36). As the individual is left to grapple with the traumatic event and the resulting disruption to their view of themselves and the world, their sense of self can begin to fragment. Unmet selfobject needs, in turn, leaves them vulnerable to emotional disruptions beyond their initial trauma reaction, such as depression, loneliness, and pain (34, 37).

Given the ongoing stress, potential for traumatic experience, and social isolation caused by quarantine, it seems that there are numerous parallels between the theory of self psychology and the stressors facing healthcare workers during this crisis. However, the relevance of selfobject needs for residential healthcare workers requires empirical study. What is particularly needed is an investigation of the role of the specific selfobject needs within the context of the psychological symptoms experienced by these healthcare workers, which may help to identify interventions to promote psychological resiliency.

The current study addresses this in a sample of residential healthcare workers in the metropolitan Detroit, Michigan (USA) region during the initial peak COVID-19 infection. At the time of the study, Michigan was among the top 10 ranked states in the number of confirmed cases and deaths (38), with the majority presenting in the metropolitan Detroit region, and approximately a third of deaths had been reported from residential healthcare facilities (39). Self-reported trauma symptoms were considered a proxy for the healthcare employee's current experience of distress or trauma during the COVID-19 pandemic, as well as reported severity of depression, anxiety, and perceived stress with established clinical measures. We tested the following hypotheses. First, greater selfobject need correlates with higher reports of symptoms of trauma, depression and anxiety, and greater perceived stress. Second, greater selfobject need will

increase the positive association of trauma symptoms with depression and anxiety symptom severity, consistent with an exacerbated effect of trauma on mental health.

MATERIALS AND METHODS

Participants

Employees in residential healthcare settings in the metropolitan Detroit region were surveyed through an anonymous, online platform from April 29 to May 14, 2020. The sample was recruited through email addressed to employees and directors of local residential healthcare agencies including assisted living communities, nursing homes, and in-home care. Potential participants were contacted through an email listserv, which local healthcare workers had joined to learn about research and education opportunities. Administrative staff and directors of local agencies were also contacted by email and were asked to distribute the survey information among staff. Of the 148 individuals who initiated the survey, 103 completed responses to all survey items; data were missing at random [Little's $\chi^2_{(16)} = 14.78$, $p = 0.54$] and the sample with complete data were included in the current report. The sample of 103 employees (90.3% female) were on average middle-age ($M = 52.32$, $SD = 11.22$; range = 24–79 years). The sample was predominantly non-Hispanic White (72.8%) and Black (12.6%), all other racial and ethnic groups included few respondents (total 7.8%); 6.8% of the sample declined to report. Consistent with a prior published report of traumatic experience of healthcare workers in a previous SARS pandemic that was associated with social isolation and attachment insecurity (9), the current study was planned for a minimum target sample size of 100 to power (>0.80) tests to detect moderate effect sizes ($f^2 \geq 0.08$) to significance ($\alpha = 0.05$). The study was approved by Institutional Review Boards; all participants provided consent by initiating the online survey after reading the study information.

Measures

Arble Estimate of Selfobject Pursuits

The Arble Estimate of Selfobject Pursuits (AESOP) is a 31-item measure of selfobject needs. Separate scores are generated for each of the three proposed selfobject needs: Mirroring, Twinship, and Idealizing. All items are scored on a 1 (“Not at all true of me”) to 7 (“Very true of me”) scale, with higher scores reflecting greater amounts of unmet needs. Sample items include: “I feel that people do not appreciate the struggles I’ve had to face.” The AESOP was developed by clinicians and researchers operating within a self psychology framework (20). In its initial study, a sample of 686 participants completed the measure, and an exploratory factor analysis was conducted (20). A three-factor solution was identified, corresponding to the three identified selfobject needs. In a second study, a sample of 672 respondents completed the measure, as well as a number of related measures (20). The three-factor structure that was identified with the EFA from the previous study was confirmed using a latent modeling technique. The items were entered into a confirmatory factor analysis (CFA); model fit was evaluated with a compendium of accepted fit indices, all indicating adequate-strong fit. This

second analysis is critical, as the AESOP's structure has been identified in both exploratory and confirmatory analyses, offering it a unique strength as compared to other measures of selfobject needs, such as the SONI (22). The use of both exploratory and confirmatory analyses is highly beneficial for measurement validation, as due to constraints within the modeling process, confirmatory and exploratory analyses can produce discrepant results and do not share the same assumptions (40, 41). The SONI, while generally demonstrating theoretically consistent patterns of relationships with the AESOP, has not fared as well in subsequent psychometric analyses, with its proposed factor structure proving somewhat tenuous (20, 42).

Finally, cluster and discriminant function analyses provide strong evidence of the AESOP's convergent and discriminant validity (20). AESOP scale scores in the sample had good internal consistency: Cronbach's $\alpha = 0.93, 0.82$, and 0.85 , Mirroring, Idealizing, and Twinship, respectively, which is in agreement with the prior report of a community sample (20). Means and standard deviations of the published normative sample of 672 respondents (20) were used to calculate standardized scores to evaluate the similarity of responses collected during the pandemic to typical responses: standardized scores equal to zero indicate responses equal to the normative sample mean and variation is scaled to the standard deviation. All hypotheses tests were completed with the sample scale scores.

Depression and Anxiety Stress Scales-21

The Depression and Anxiety Stress Scales-21 (DASS-21) is a 21-item measure of depression, anxiety, and stress (43). Separate scores are generated for each of the respective clinical constructs. All items are scored on a 0 ("Never") to 3 ("Almost Always") scale, with higher scores reflecting greater levels of symptoms. Sample items include: "I felt that I had nothing to look forward to." The measure's reliability and validity have been established in numerous studies, and it has been utilized in recent research among healthcare workers (44). Depression and Anxiety Stress Scales-21 scale scores had good internal consistency, Cronbach's $\alpha = 0.91, 0.83$, and 0.91 for depression, anxiety and stress scales, respectively, similar to other reports of non-clinical community samples (45, 46).

PTSD Checklist for DSM-5

The PTSD Checklist for DSM-5 (PCL-5) is a 20-item measure of PTSD symptoms (47). Items are rated on a 0 ("Not at all") to 4 ("Extremely") scale, with higher scores reflecting greater levels of trauma symptoms. Sample items include: "Being 'superalert' or watchful or on guard?" The PCL-5 is a popular measure of PTSD symptoms and has been found to be a reliable and valid instrument (48), and had high internal consistency in the present sample (Cronbach's $\alpha = 0.95$), similar to another report of trauma-exposed, community sample (49). The PCL-5 is sometimes supplemented with measures of Criterion A, the PTSD diagnostic criteria requiring that the individual be exposed to a traumatic event. These supplemental measures can take the form of checklists (e.g., a list of potentially traumatic events that the respondent

can endorse the experience of) or free-from responses where the individual reports and describes the traumatic event they experienced. These supplements were not administered in this survey, meaning that while the present PCL-5 score can provide a measure of trauma symptoms, they cannot be interpreted as a diagnosis.

Statistical Analysis

Prior to hypothesis testing, data were screened for normality of univariate distributions, as well as cases that were outliers to the sample. Distributions of depression, anxiety, and perceived stress scores were positively skewed; because the scale scores have clinical interpretations that would be lost if a transformation were applied, hypothesis tests were selected that provide robust estimates for non-normal distributions and original scale scores were used in all analyses. Two cases were identified as univariate (z -score $> |3.29|$) or multivariate outliers (Mahalanobis distance, critical $\chi^2 = 24.322$, $\alpha = 0.001$). Regression estimates are vulnerable to bias from extreme or leverage cases; however, maintaining the complete eligible sample improves the external validity of the estimates. Therefore, all analyses were conducted with complete data ($N = 103$) and hypothesis tests were repeated after removing outlier cases to confirm negligible bias in the estimates.

Hypothesis 1 was tested with Spearman correlations (ρ), which do not require a normal distribution for valid estimates (50), including bias-corrected bootstrapped 95% confidence intervals [5,000 draws (51); BS 95% CI], which if not overlapping with zero would provide further support for the hypothesized relation. Possible differences in the magnitude of the correlation with mental health outcomes between selfobject needs were tested with Steiger Z (52). To account for the multiple comparisons made, all significance testing was adjusted for false discovery rate (FDR-adjusted q -value) (53).

Hypothesis 2 of selfobject need as a moderator of the effect of trauma symptoms on depression and anxiety symptom severity was tested in a two-level repeated measures general linear model with multivariate estimates, which does not require normal univariate data distributions for valid estimates in large samples (54) and takes into account the correlations among scale responses for depression and anxiety. The model included trauma symptoms, scale scores for Mirroring, Idealizing, and Twinship, and two-way interactions with each, as independent variables predicting depression and anxiety as a two-level repeated measurement (Depression/Anxiety). To alleviate expected multicollinearity among predictors and to allow comparisons across sub-scales, the selfobject need measures were converted to sample z -scores prior to model estimation. All multivariate F -tests are reported with standardized effect sizes (η_p^2). Significance of the interaction term ($\alpha = 0.05$) and 95% CI not overlapping zero were accepted as evidence of moderation; omnibus effects were decomposed with univariate, hierarchical regression procedures.

TABLE 1 | Bivariate correlations among selfobject needs and self-report mental health among residential healthcare workers.

		1	2	3	4	5	6
1	Mirroring	1.00					
2	Idealizing	0.60 (0.44/0.72)	1.00				
3	Twinship	0.53 (0.37/0.67)	0.73 (0.61/0.81)	1.00			
4	PTSD	0.68 (0.57/0.76)	0.41 (0.23/0.55)	0.47 (0.30/0.61)	1.00		
5	Depression	0.64 (0.49/0.76)	0.33 (0.14/0.50)	0.49 (0.31/0.64)	0.77 (0.67/0.84)	1.00	
6	Anxiety	0.59 (0.46/0.70)	0.33 (0.14/0.49)	0.32 (0.13/0.50)	0.77 (0.68/0.84)	0.65 (0.50/0.77)	1.00
7	Stress	0.62 (0.49/0.73)	0.46 (0.29/0.60)	0.52 (0.37/0.64)	0.84 (0.78/0.89)	0.74 (0.65/0.81)	0.66 (0.54/0.75)

Bivariate Spearman correlations (ρ) are reported with bias-corrected bootstrapped 95% confidence intervals (lower limit/upper limit). All correlations were significant after FDR correction, $q < 0.001$.

RESULTS

Sample Description

The survey participants ($N = 103$) reported 1–46 years of experience working in residential healthcare ($M = 20.35$, $SD = 12.91$). Reported job titles and descriptions indicated a wide representation of roles within the setting. The majority of participants were social workers (33.0%), followed by nurses (16.5%), agency directors or owners (17.5%), occupational therapists (6.8%), specialty consultants or care coordinators (5.8%), administration or technical staff (5.8%), psychologists (3.9%), nurse assistants (3.9%), and physical therapists (1.9%). Other respondents reported a role as doctor, sales associate, and human resources.

Scores across the measures of PTSD (range = 0–62; $M = 20.56$, $SD = 16.76$), depression (range = 0–20; $M = 4.27$, $SD = 4.79$), anxiety (range = 0–18; $M = 3.29$, $SD = 3.84$), and perceived stress (range = 0–18; $M = 6.14$, $SD = 5.02$) fell, on average, within the normal range, though 35% of individuals reported clinical elevations.

To compare the level of reported selfobject need to a normative sample of 672 respondents, we examined z-scores calculated from the published means and standard deviations (20): Mirroring ($M = -0.46$, $SD = 1.07$; BS 95% CI: $-0.66/-0.26$), Twinship ($M = -0.65$, $SD = 1.18$; BS 95% CI: $-0.85/-0.43$), and Idealizing ($M = -0.93$, $SD = 1.26$; BS 95% CI: $-1.17/-0.70$). Based on the BS 95% CI, the average response on all scales did not overlap with zero and indicated that responses were lower than the normative reference. Therefore, reported responses in this sample are within the normal range of reported selfobject needs observed in the reported community sample (20).

Hypothesis 1: Correlation of Selfobject Need With Mental Health

Bivariate correlations between selfobject needs and self-report mental health outcomes are reported in **Table 1**. As expected, responses to Mirroring, Idealizing, and Twinship scales were positively correlated. Across sub-scales, higher selfobject need positively correlated with greater experience of depression, anxiety and trauma symptoms, and perceived stress. Comparing the magnitude of the correlation coefficients, Mirroring was more strongly correlated with symptom severity than Idealizing

across all symptom domains (all $z \geq 3.47$, $q \leq 0.01$), and more strongly correlated with trauma and anxiety symptoms severity as compared to Twinship (both $z \geq 2.90$, $q < 0.01$). Mirroring was also more strongly associated with perceived stress as compared to Idealizing ($z = 2.25$, $q = 0.04$) but not Twinship ($z = 1.35$, $q = 0.21$). Twinship was more strongly correlated with depression as compared to Idealizing ($z = -2.46$, $q = 0.03$), but each were similarly correlated with anxiety ($z = 0.15$, $q = 0.88$) and trauma symptoms ($z = -0.93$, $q = 0.38$). In sum, higher selfobject need was associated with worse reports of depression, anxiety, trauma, and distress symptoms, and the relation was, in general, stronger with Mirroring as compared to Idealizing and Twinship.

Hypothesis 2: Selfobject Need Moderates the Effects of Trauma Symptoms on Depression and Anxiety

We hypothesized that high reports of trauma symptoms would be associated with high severity of depression and anxiety symptoms, and that greater selfobject need would worsen these relations. Higher trauma symptom severity significantly predicted mental health outcomes [$F_{(1,97)} = 103.36$, $p < 0.001$; $\eta_p^2 = 0.52$]. The effect of trauma symptom severity was moderated by Mirroring, and the magnitude of this complex effect differed between anxiety and depression (Depression/Anxiety $\times$ Trauma $\times$ Mirroring): $F_{(1,97)} = 4.74$, $p = 0.03$; $\eta_p^2 = 0.05$. There was no evidence of Twinship [$F_{(1,95)} = 1.18$, $p = 0.28$] or Idealizing [$F_{(1,95)} = 0.002$, $p = 0.96$] moderating the effect of trauma symptoms on mental health outcomes. Therefore, these interaction terms were removed from the model.

To further examine the complex interaction between trauma symptoms and Mirroring in predicting depression and anxiety differentially, we evaluated univariate regressions in a *post-hoc* analysis. Mirroring significantly moderated the relation between trauma symptoms and depression (Trauma $\times$ Mirroring): $b = 0.003$, $p = 0.01$; 95% CI: 0.001/0.005; $\Delta R^2 = 0.02$. Individuals with higher Mirroring need demonstrated a stronger positive relation between trauma symptoms and depression symptoms (**Figure 1**). Depression scores 11 and higher indicate “severe” to “extremely severe” levels; notably individuals who reported lower Mirroring need did not pass this threshold despite reporting elevated trauma symptoms. Trauma symptoms and Mirroring,

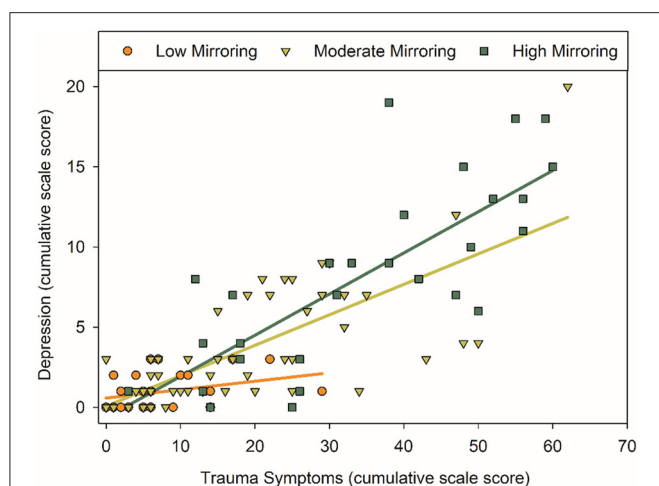


FIGURE 1 | The association between PTSD and depression symptoms was moderated by Mirroring need. All analyses treated cumulative scale scores as continuous variables; for the purpose of illustration, Mirroring need is depicted at low ($\geq 25^{\text{th}}$ percentile), moderate, and high ($\geq 75^{\text{th}}$ percentile) levels as observed in the sample. Higher PTSD symptoms were positively correlated with higher depression symptoms. This association was more strongly positive at moderate and high levels of Mirroring ($b = 0.003$, $p = 0.01$, $\Delta R^2 = 0.02$). Depression scores 11 and higher indicate “severe” to “extremely severe” levels; notably individuals who reported lower Mirroring need did not pass this threshold despite reporting elevated PTSD symptoms.

together, accounted for a large proportion of variance in reported depression symptoms (model $R^2 = 0.69$, $p < 0.001$). There was no evidence of Mirroring moderating the relation between trauma symptoms and anxiety ($b = 0.00$, $p = 0.71$; 95% CI: $-0.002/0.002$; $\Delta R^2 = 0.001$), but high Mirroring need and trauma symptoms accounted for approximately half of the variance in anxiety symptom severity (model $R^2 = 0.59$, $p < 0.001$). Repeating the analysis after removing two cases that were statistical outliers replicated the same pattern of results: Mirroring moderated the relation between trauma symptoms and depression ($b = 0.003$, $p < 0.01$; 95% CI: $0.001/0.004$; $\Delta R^2 = 0.02$) but not anxiety ($b = 0.00$, $p = 0.88$; 95% CI: $-0.002/0.002$; $\Delta R^2 = 0.00$). Taken together, trauma symptoms was the strongest, unique predictor of depression and anxiety symptom severity, and higher Mirroring need exacerbated the effect on depression.

DISCUSSION

We report on a diverse sample of residential healthcare workers who were active during the initial peak COVID-19 infection in a strongly impacted metropolitan region. Participants reported a change in daily activities from COVID-19, as well as elevations in distress, trauma, depression, and anxiety symptoms. Selfobject needs presented as a strong correlate of these clinical symptoms across all domains. Although a proportion of individuals reported clinical elevations, the average responses indicated many symptoms fell within normal range. This evidence that is consistent with emotional resiliency, despite disruption to daily activity and distress, is promising. In the current report

we explored a possible source of resiliency in the correlation of selfobject needs with symptom profiles. High Mirroring need worsened the association between trauma symptoms and depression severity; and consistent with resiliency, those with low Mirroring need did not report clinically severe depression symptoms despite experiencing trauma symptoms.

As understood by Kohut, unmet selfobject needs disrupt core aspects of a person’s internal world, thereby leaving them vulnerable to a variety of deleterious outcomes. In line with this theory, each of the three selfobject needs correlated with all of the clinical outcomes assessed. As would be theoretically expected, individuals reporting higher levels of unmet selfobject needs were more likely to report greater levels of trauma symptoms, depression, anxiety, and stress. In many respects, identifying that a person is in a state of need (i.e., having their selfobject needs unfulfilled) may be a powerful indication that they are in danger of experiencing a variety of associated psychological concerns. Given the challenges facing those working in residential healthcare, the field would do well to pay careful attention to these indicators.

Witnessing patient illness and death, fears of contracting COVID-19, and the strain of quarantine all leave healthcare workers in residential healthcare vulnerable to traumatic exposure and resulting symptoms. High trauma symptom severity and traumatic experiences increase the risk to develop major depressive and anxiety disorders (55), and comorbid symptom profiles have been reported in frontline healthcare workers during traumatic events (56, 57). However, most people undergoing a traumatic event are unlikely to develop lasting symptoms of trauma (58). We were thus curious as to the role that selfobject needs might play in moderating the association between experience of trauma symptoms and the symptoms of other mood disorders, particularly given the connection between PTSD and emotional reactivity (59). Although each of the three selfobject needs positively correlated with mental health symptom severity, the correlation with Mirroring need was in general stronger than that with Idealizing and Twinship needs. In community samples, Mirroring has been previously found to be a stronger correlate of self-reported mental health symptoms than the other selfobject needs, and the effect is general and does not discriminate between symptom domains (20). This may indicate that Mirroring is more easily accessible among community samples due to its connection with self-esteem (13–16), whereas Twinship and Idealizing needs differentiate clinical elevations in personality and psychological symptoms (20) that were not observed in this sample. Mirroring emerged as particularly important in understanding the relation between trauma symptoms and depression—among individuals who reported higher levels of unmet needs for Mirroring, the association between trauma symptoms and depression was strengthened. When considering the recommended cutoffs of the depression scale, reports >11 would indicate clinically severe symptoms, and notably healthcare workers who reported low Mirroring need did not have severe elevations in depression symptoms despite experiencing trauma symptoms. Mirroring need, trauma symptoms and the interaction together accounted for 69% of variance in depression symptom severity. Mirroring

need and trauma symptoms also accounted for 59% of variance in anxiety symptom severity, but there was no evidence of a moderating effect. The differential effects between depression and anxiety symptoms may reflect the circumstance of the data collection. Residential healthcare workers were surveyed during the initial infection wave, when the nature of COVID-19 disease transmission was poorly understood, rapid testing was not widely available, policies were rapidly changing, and a vaccine was a distant promise. In these circumstances, acute sub-clinical elevation in anxiety may be typical and correlated with but not modified by selfobject need, whereas acute depression symptoms plausibly can be modified in that context. Although speculative, this suggests the intriguing possibility that by satisfying the need for Mirroring, some of the negative consequences of trauma exposure could be blunted, even during acute responses to trauma before chronic disorders arise.

Mirroring consists of receiving recognition for one's efforts thereby resulting in the "mirroring" of one's value. Mirroring is critical to the development and maintenance of self-esteem (13–16). From the present study's results, it appears that meeting one's needs for Mirroring can increase resiliency to negative events, an important benefit during the ongoing pandemic. Fortunately, the idea of Mirroring as a universal human need that can be fulfilled by people in a healthcare professional's life makes it an excellent target for intervention. Whereas, some interventions may be developed for specific occupations or diagnoses, an emphasis on Mirroring should prove beneficial for all the diverse professionals engaged in residential healthcare. And the ability to provide mirroring to someone does not require special station or expert training; a willingness to empathetically understand the struggles of healthcare professionals and expressing appreciation for their contributions may be sufficient to provide a significant amount of emotional assistance.

Consistent with the present results, previous research has identified that recognition significantly influences stress levels in healthcare professionals (60). Following the previous SARS-CoV-1 pandemic, preventative strategies at an organizational level were suggested to aid frontline healthcare workers to adequately cope with traumatic experiences, and in particular, psychosocial support was identified as an effective tool (9). The literature thus appears to support Kohut's core assertion that the quality of one's relationships, both longstanding and recent, predict the length and severity of symptoms following trauma or adversity (29, 31).

For healthcare systems and employers who identify that their providers are struggling socially or emotionally, there may be some utility in organizational programs focused on building and fostering personal and professional relationships. This is particularly advisable in times of strain such as the present outbreak; due to quarantine, healthcare workers may find themselves isolated from the very support that might be beneficial. Creating a supportive space with time to reflect and evaluate emotional experiences are key aspects of empathic listening that have been shown to ameliorate psychological symptoms, compassion fatigue, and occupational burn-out among nurses, social workers and psychologists (61, 62). There are some examples of organization-level interventions around selfobject needs in clinical care of the elderly (63), and a

similar structured approach may be useful when supporting residential healthcare workers. Furthermore, there are available resources to help utilize self psychology principles in a group context (64). Future studies of intervention designs and mental health outcomes will be necessary to implement meaningful and feasible organization-based programs. Facilitating meaningful social connection, directly providing recognition and expressing appreciation for individual healthcare worker's value, and being mindful of the well-being of people employed in residential healthcare, all appear as practical and important tools for our healthcare systems to utilize.

Limitations

Although this study provides valuable information for the applicability of selfobject needs in understanding and reducing psychological symptoms among healthcare workers, it is not without limitations. The main limitation involved the circumscribed nature of the present assessment and its reliance on self-report questionnaires, which are subject to issues concerning accuracy and self-presentation biases, particularly in the case of selfobject needs. Given that selfobject responsiveness is key to the self psychology conceptualization of psychopathology, considerable theoretical consideration has been given to understanding the experiences of those whose developmental histories were marked by a lack or disruption of these needs. Kohut noted that a child whose pursuit of selfobject needs is characterized by pain and rejection may develop a defensive strategy where this core need is rejected and denied (65). For these individuals, the pursuit of selfobject needs has proven so painful and unsuccessful, they deny the need for pursuit altogether. Unfortunately, this denial cannot provide deep and longstanding emotional fulfillment. In a self-report measure such as the AESOP, an individual using this defensive style can simply deny their experiences, meaning that their state of emotional needs could be undetected. It is unclear if a more thorough assessment (e.g., using clinical interviews) would yield similar results. A more comprehensive assessment, including a view of the participants' relational/developmental history, could better illuminate some of the theoretical concepts being explored.

Second, the present results could only consider symptom totals, as opposed to diagnostic categories. A single self-report measure cannot diagnose a condition such as PTSD, and it would be interesting to consider if the same pattern of correlations would be observed amongst those meeting diagnostic criteria. The inability to offer a diagnosis is particularly relevant in the case of PTSD, as the present assessment did not include a measure of Criterion A (i.e., confirmation of the presence, and nature of, a traumatic experience). Scores on the PCL-5 are driven by symptoms reported in response to "stressful experiences" which may not be traumatic in nature. Even if a traumatic experience was present within the sample, there is no way to confirm that the trauma was in any way related to their occupational experiences. Furthermore, we only evaluate the acute response during the initial peak COVID-19 infection in the region, and symptom severity and chronicity that indicate a clinical disorder may be evident after more time. It is thus important to note that

when referencing concepts such as trauma symptoms from PCL-5 responses or selfobject needs, the present research can only provide proxies for these concepts, meaning that interpretation of the observed correlations should be approached conservatively.

Third, several factors related to the source of distress, organizational resources, and occupational role may modify the healthcare worker's experience of trauma during the pandemic. This convenience sample included participants in a multitude of roles, the majority of whom were nurses and social workers, and a small number in administrative roles. Based on sweeping policy changes and public health initiatives (1), any employee in a residential healthcare facility is expected to experience disruption and anxiety for disease exposure, but not all employees will have direct experiences with patient care. Indeed, sources of distress and trauma related to organization resources, such as personal protective equipment or inadequate staffing, is expected to differentially affect frontline healthcare more than administrative staff working in the same environment. The available sample was insufficient to test the hypothesis of occupational role moderating psychological symptom severity, its interaction with selfobject need, or different sources of distress. Similarly, the convenience sample was generally consistent with the demographics reported of regional residential healthcare workers, but Black healthcare workers were under-represented. Social and behavioral determinants of mental health contribute to increased experience of trauma and its consequences for Black adults (66) and we cannot evaluate possible racial and ethnic differences in the current sample. The limited data collection through anonymous survey also precluded analyses of selection bias related to missing data responses. Future studies should endeavor to not only improve sample diversity, but also consider mixed methods approaches to systematically evaluate the complete experience of the residential healthcare workforce across occupations.

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CONCLUSION

In summary, we report on a diverse sample of healthcare workers in residential healthcare settings throughout the metropolitan Detroit region during the peak of the initial COVID-19 infection. Employees in these settings experienced a substantial disruption to daily activities. Although some individuals reported elevations in trauma symptoms, depression, and anxiety symptoms, and heightened stress, the average response on these scales fell within normal range. Selfobject needs presented as a strong correlate of symptom severity across the domains, and greater Mirroring need, in particular, exacerbated the relation between the experience of trauma symptoms and depression. Emphasizing the importance of relational needs such as Mirroring for healthcare workers in residential healthcare is a feasible approach to promote resiliency in mental health following traumatic experiences during the COVID-19 pandemic and after.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Eastern Michigan University IRB. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

EA, SS, SWS, and AD all contributed to the study's conceptualization and the writing of the manuscript. EA and AD conducted data collection and analysis. All authors contributed to the article and approved the submitted version.

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Predictive Analysis of Factors Influencing Depression Status of Nurses in the COVID-19 Pandemic Intensive Care Unit

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Purpose: Understand the effects of the COVID-19 pandemic on depression in intensive care unit (ICU) nurses, analyze high-risk factors, and propose appropriate measures to maintain physical and mental health.

Methods: A total of 78 nurses in ICU of Beijing Ditan Hospital affiliated with Capital Medical University (Beijing area, COVID-19 patient designated hospital) were investigated with self-rating depression scale (SDS). The Cronbach's α coefficient was 0.874, the content validity was 0.853, and the internal consistency was good. General information for the questionnaire: gender, marriage, education, age, title, length of service, ICU years of service, COVID-19 pandemic training, concerns about the COVID-19 pandemic, and current health status.

Results: According to the SDS scale score, ICU nurses had a total depression score of 51.36 ± 11.667 , and the prevalence rate of depression was 44.9% (35/78). Multi-line regression analysis shows that stress perception, work experience in critical diseases, education and other total scores are risk factors for the occurrence of depression.

Conclusion: Work experience in critical illness ($\beta = 9.930$, $P < 0.001$) had a positive predictive effect on the total score of depression, while stress perception ($\beta = -0.884$, $P < 0.001$) and education ($\beta = -6.061$, $P < 0.001$) had a negative predictive effect on the total score of depression, and explained 52.7% variation. These findings point to the need for interventions to address psychological distress and provide the necessary support.

Keywords: NCP, ICU nurses, depression, influencing factors, psychological interventions

OPEN ACCESS

Edited by:

Carlo Lai,
Sapienza University of Rome, Italy

Reviewed by:

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Catholic University of the Sacred
Heart, Italy
Zainab Zadeh,
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Specialty section:

This article was submitted to
Mood Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 10 September 2020

Accepted: 06 October 2021

Published: 16 November 2021

Citation:

Li J, Zhang Y, Li L, Yi W, Hao Y and
Bi Y (2021) Predictive Analysis of
Factors Influencing Depression Status
of Nurses in the COVID-19 Pandemic
Intensive Care Unit.
Front. Psychiatry 12:596428.
doi: 10.3389/fpsy.2021.596428

INTRODUCTION

Currently, COVID-19 has been alleviated in China, but the global epidemic is on the rise (1). The epidemic is characterized by unpredictability, sudden onset, rapid spread, complex causes, difficult treatment and severe disability. The number of infected patients has increased dramatically. In addition, there have been reports of COVID-19 pandemic nosocomial infections in China and other countries (2), which have a significant impact on health and physical and mental well-being of health care workers and can lead to depression. The intensive care unit (ICU) is the primary place for treating patients with severe COVID-19 and plays a key role in the fight against the

COVID-19 pandemic. The World Health Organization (WHO) focuses on maintaining the physical and mental health of those involved in the relief effort and improving the physical and mental health of all employees (3). However, at present, there are few investigations on ICU nurses' depression, and there is a lack of operational psychological intervention methods. Usman et al. (4) discussions, that can be beneficial to reduce the psychological sufferings by ensuring the protection of the health-care workers to facilitate proper services in combating with the COVID-19 crisis. In addition, Sakib et al. (5) suggesting the urgent need to promote mental well-being in medical professionals. Therefore, it is urgent to identify the influencing factors of ICU nurses' depression. This study predicted and analyzed the influencing factors of depression state of nursing staff in designated hospitals for COVID-19 pandemic, and developed corresponding nursing measures, so as to provide reference for psychological intervention of ICU nurses during COVID-19 pandemic.

STUDY PROCEDURE AND PARTICIPANTS

Study Participants Inclusion Criteria

A questionnaire survey was conducted on 78 ICU nurses in Beijing COVID-19 pandemic designated hospital in March 2020 using cluster sampling. The inclusion criteria were as follows: (i) work in ICU; (ii) on duty; (iii) willing to participate in the survey. The exclusion criteria were as follows: (i) within 1 year of pregnancy and postpartum; (ii) family changes within 6 months of investigation; (iii) nurses with severe acute and chronic diseases; (iv) nurses with original mental and other mental illnesses. The studies involving human participants were reviewed and approved by the ethics committee of Beijing Ditan Hospital Capital Medical University. Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Instruments

Study Procedure

A cross-sectional survey was conducted and the data were collected by "Questionnaire Star." Each section is set as a mandatory option. The respondents filled in and submitted the questionnaire independently within 5 min. Participants completed the scale by scanning the code, input the ICU work information, and obtained SDS and Perceived stress scale (PPS).

Survey Tools: The Questionnaires Were Used as Research Tools

The specific contents of the questionnaire include:

(1) General information: Gender, marriage, education, age, job title, working years, ICU working years, COVID-19 pandemic training, concerns about COVID-19 pandemic, and current health status, work experience of critically ill patients (At least 1 years working experience in ICU), perceived stress scale (PPS), Confident to complete the work (independent willingness), etc.

(2) Self-Rating Depression Scale (SDS) (6): The questionnaire was compiled by William w. k. Zung in 1971. It is easy to use

and can directly reflect the subjective feelings of patients with depression. There are 20 items in the scale, the positive score is 1, 2, 3, 4, and the reverse score is 4, 3, 2, 1. Reverse scoring question number: 2, 5, 6, 11, 12, 14, 16, 17, 18, and 20. The cumulative score of each item is the total rough score, which is multiplied by 1.25 to get the standard total score. A standard total score of <53 was not considered to be depressed, and a standard total score of more than 53 was considered to be depressed (53–63 was considered mild depression, 64–74 was considered moderate depression, and 75 or more was considered severe depression). The higher the score, the more severe the depression. Cronbach's α coefficient was 0.874, content validity was 0.853, and internal consistency was good.

(3) Perceived stress scale (PPS) (7): The scale consists of 14 items, and each item uses a 5-level scoring method (0–4). The total score is the sum of the scores of each item, ranging from 0 to 56. The higher the score, the greater the perceived pressure. The Chinese version of PSS has been tested to have sufficient retest reliability ($r = 0.81$), internal consistency (Cronbach's $\alpha = 0.85$), and structural validity.

Statistical Analysis

Spss20.0 statistical software was used for data analysis. Descriptive analysis was used for demographic and clinical variables. Measurement data are expressed as mean $\pm$ standard deviation, and count data are expressed by frequency or percentage. If two or more sets were measurement data of normal distribution and approximate normal distribution, t -test or one-way analysis of variance was used for comparison, while two or more sets of measurement data that do not satisfy the normal distribution were compared using Mann-Whitney U nonparametric rank-sum test. Multiple stepwise regression analysis was used to analyze the influencing factors of depression of ICU nurses; $p < 0.05$ indicated statistical significance.

RESULTS

General Information

In this survey, the cohort consisted of 14 (17.95%) males and 64 (82.05%) females. The age group ≤ 25 -years-old consisted of 13 (16.47%) nurses, 26–39-years-old age group had 62 (79.49%) nurses, and age group ≥ 40 -years-old consisted of 3 (3.85%) nurses. Eighteen (23.08%) nurses had <5 years of experience, 30 (38.46%) nurses had 5–10 years of experience, 17 (21.79%) nurses had 11–15 years of experience, and 13 (16.67%) nurses had >15 years of experience. The level of education was as follows: 18 (23.08%) nurses were at the college level or less, and 60 (76.92%) nurses were undergraduates. Nineteen (24.36%) nurses had the title of general, 36 (46.15%) were senior, and 23 (29.49%) were supervisors and above (Table 1).

Depression Status of ICU Nurses Fighting Against COVID-19

According to the SDS scale score, the total depression score of ICU nurses was 51.36 ± 11.667 , among which 35 nurses had a score >53, and the prevalence of depression was 44.9%.

TABLE 1 | Univariate analysis of depression in ICU nurses combating COVID-19 pandemic (mean $\pm$ sd, $n = 78$).

Project	Category	Number of cases (%)	SDS total score (points)	T/F	P-value	Project	Category	Number of cases (%)	SDS total score (points)	T/F	P-value		
Gender	Male	14 (17.95)	45.54 ± 11.004	−2.108	0.038	Infectious ward work experience	Yes	56 (71.79)	53.53 ± 11.512	7.402	0.008		
Age (years)	Female	64 (82.05)	52.64 ± 11.498	0.340	0.713	Major epidemic Experience	No	22 (28.21)	45.85 ± 10.368	0.782	0.397		
	≤25	13 (16.67)	50.67 ± 13.680				Yes	39 (50)	52.53 ± 11.7421				
	26–39	62 (79.49)	51.75 ± 10.931				No	39 (50)	50.19 ± 11.626				
	≥40	3(3.85)	46.25 ± 20.653				yes	74(94.87)	50.22 ± 10.660				
Working (years) age	<5	18 (23.08)	48.89 ± 10.008	0.514	0.674	Control training	No	4 (5.13)	72.50 ± 10.052	−1.078	0.285		
	5–10	30 (38.46)	52.87 ± 13.491			Knowledge of prevention control	Good	60 (76.92)	50.58 ± 11.127				
	11–15	17 (21.79)	52.28 ± 10.498			Work experience of critically ill patients	Average	18 (23.08)	53.96 ± 13.327				
	>15	13 (16.67)	50.10 ± 11.267			Yes	67 (85.9)	49.93 ± 11.469					
Education	College above	18 (23.08)	57.99 ± 10.183	8.253	0.005	Work place before COVID-19 pandemic	No	11 (14.1)	60.11 ± 9.256	−2.801	0.006		
	Undergraduate	60 (76.92)	49.38 ± 11.418				Hospital ICU	34 (43.59)	53.20 ± 11.899			3.015	0.055
	Master above	0 (0)					Hospital ward	30 (38.46)	52.42 ± 10.857				
Title	Nurse	19 (24.36)	49.93 ± 11.445	0.187	0.830	Clinical front line working hours	Hospital top three	14 (17.95)	44.64 ± 11.131	4.461	0.006		
	Senior nurse	36 (46.15)	51.74 ± 12.770				≤7 days	13 (16.67)	42.88 ± 10.044				
	Supervisor	23 (29.49)	51.96 ± 10.368				8–14 days	8 (10.26)	45.78 ± 9.496				
Marital status	Marriage	50 (64.1)	51.75 ± 11.504	3.261	0.044	Pressure perception	15–21 days	8 (10.26)	53.75 ± 7.258	8.622	0.000		
	Unmarried	27 (34.62)	49.63 ± 11.022				>21 days	49 (62.82)	54.13 ± 11.785				
	Divorce	1 (1.28)	78.75				None	15 (19.23)	43.92 ± 9.553				
	Yes	27 (34.62)	54.40 ± 12.136				Yes slightly larger	33 (42.30)	49.37 ± 9.720				
Only child													
Child	No	51 (65.38)	49.75 ± 11.200				Yes larger afford	28 (35.89)	57.86 ± 11.226				
Sleep condition	Worse	61 (78.21)	53.95 ± 10.847	8.228	0.001	Confident to complete the task	Yes largest crash	2 (2.56)	65.63 ± 7.955	−6.079	0.000		
Condition	Constant	16 (20.51)	42.19 ± 10.119				Yes	69 (88.46)	48.97 ± 9.870				
	Get better	1 (1.28)	40.00				No	9 (11.54)	69.72 ± 7.310				
State of health	Good	42 (53.85)	46.55 ± 10.942	15.919	0.000								
	Average	33 (42.31)	55.38 ± 8.652										
	Poor	3 (3.85)	74.58 ± 5.204										

Among these, 19 (24.4%) were mildly depressed, 13 (16.7%) were moderately depressed, and 3 (3.8%) were severely depressed.

ICU Nurses' Stress Perceptions Against the COVID-19

The pressure perception of the ICU nurses who fought against the COVID-19 was 33.85 ± 7.749 , of which the tension score was 17.41 ± 4.966 , and the control sense score was 16.44 ± 5.949 . A total of 24 (30.80%) individuals felt normal, 42 (53.80%) felt slightly more stressed, and 12 (15.40%) felt extreme pressure.

Single-Factor Analysis of ICU Nurses' Depression Status That Affected the COVID-19

The depression status of ICU nurses in different groups was compared by variance analysis. Differences in gender, education, health, sleep, COVID-19 outbreak prevention and control emergency training, front-line working hours, confidence in completing tasks, stress perception assessment and other factors are statistically significant ($p < 0.05$; Table 1).

Multi-Factor Analysis of ICU Nurses' Depression Status That Affected the COVID-19

Based on the statistically significant factors of difference as the argument, the multi-step regression analysis was carried out with the total depression divided into dependent variables. The total score of stress perception, the total score of critical work experience and the total score of education level enter the regression equation. Among them, critically ill work experience ($\beta = 9.930$, $p < 0.001$) has a positive predictive effect on the total score of depression, while the total score of stress perception ($\beta = -0.884$, $p < 0.001$) and education ($\beta = -6.061$, $p < 0.001$) had a negative predictive effect on the total depression score. The total scores of stress perception, critical work experience, and academic qualifications explained the 52.7% variation in the work input (Table 2).

DISCUSSION

Depression Status of ICU Nurses During COVID-19

In this study, the total score of depression was 51.36 ± 11.667 . The prevalence of depression between ICU nurses was 44.9% (score of more than 53). This is in line with Nickell et al. Research (8). The prevalence of depression in SARS outbreaks is 45% and may also be affected by related factors of cardiovascular health and interpersonal relationships and familiar violence (9). The depression of ICU nurses is significantly higher than that of the general population, and it also confirms the existence of mental health issues in ICU nurses in China. The working environment of ICU is specific, and severe COVID-19 pandemic patients exhibit complicated conditions and rapid changes. The ICU nurses need to withstand the extremely high risk of infection and often need to give emergency treatment within a few seconds, which is likely to cause tension. Other studies have shown that

ICU nurses are high-emotional labor groups, and improper emotional management can aggravate the imbalance of their physical and mental health (10), thereby affecting the quality of nursing work. In the face of such challenges, ICU nurses lack optimism spirit (11), and adequate emotional management can improve the negative emotions of depression of ICU nurses (12). In addition, the use of diversified emotional management, such as system stress management (13), Williams life skills training (14), mindfulness stress reduction therapy (15), reflection (16), etc., can effectively reduce the level of depression of ICU nurses, so that they can actively respond to difficult situations. At present, hospitals rarely carry out emotional management-related training, improve the ICU nurse depression in this regard has a lot of room for improvement.

Influencing Factors of Depression of ICU Nurses During COVID-19 Stress Perception

The COVID-19 pandemic is a stress event and a major cause of depression. Cohen et al. (7) suggest that "perceived stress" is an individual's psychological response to the cognitive evaluation of various stimuli in the environment. Studies have shown that perceived stress positively predicts depression (17). The higher the level of perceived stress, the more severe the depression, which is consistent with studies by Nikcevi et al. (18). ICU nurses are under more pressure than other clinical departments, which are closely related to the ICU's environment and nature of work (19). According to the American Environmental Protection Agency (20), alarm sounds (over 60 dB) are prone to negative emotions such as depression (21). Even at rest, the need to work overtime at all times can lead to tension and difficulty in relaxing. Patients with COVID-19 admitted to the ICU are in critical condition. Critical state as a bad stimulation, easy to cause nurses to produce depression (22), affecting the ICU nurse's internal and external environment, so that the human body into a stress state (23). Studies have shown (24) that social support plays an important role in protecting the physical and mental health of ICU nurses. Therefore, hospital management should provide ICU nurses with adequate logistical support and guidance to express their concerns and concerns, understand their needs, enable them to seek the attention of managers, relieve work stress, and enhance organizational belonging (25). It is recommended that hospitals have full-time psychologists to help ICU nurses relieve psychological stress.

Work Experience of Critically Ill Patients

The study showed that the depression score of nurses with critical patient work experience was 49.93 ± 11.469 , and that of nurses without critical patient work experience was 60.11 ± 9.256 . The difference between the two was statistically significant ($t = -2.801$, $p = 0.006$). Insufficient experience in critical illness may lead to a lack of professional knowledge and unskilled clinical skills, resulting in a psychological burden on nursing COVID-19 patients, leading to job burnout (26). With the increase of nurses' work experience and through systematic training and practice, nurses' professional knowledge and skills have been improved, and they can adapt to the closed and complex ICU

TABLE 2 | Results of multiple stepwise regression of influencing factors of depression.

Project	Partial regression coefficient (B)	Standard error (S.E)	Standardization regression coefficients	t	p
Constant	80.670	5.801		13.906	0.000
Total pressure perception	−0.884	0.122	−0.587	−7.259	0.000
Work experience of critically ill patients	9.930	2.648	0.298	3.751	0.000
Education	−6.061	2.241	−0.220	−2.705	0.000

environment (27) and reduce depression (28). In order to meet all kinds of difficult and high-level treatment and nursing needs of COVID-19 patients, ICU nurses must possess keen observation ability and comprehensive emergency response ability, including timely detection and active response to changes in COVID-19 patients' conditions, so as to win the golden time of emergency rescue and improve the success rate of emergency rescue (29). Nursing managers should strengthen the standardized training of ICU nurses, constantly cultivate and improve the psychological quality and ability of ICU nurses with less work experience, and constantly generate a sense of accomplishment in practical work, which can effectively reduce the occurrence of depression and other unhealthy mental states (30).

Education

In this study, the depression score of undergraduate nurses was 49.38 ± 11.418 , and that of undergraduate and below nurses was 57.99 ± 10.183 , and the difference was statistically significant. Nurse's education was negatively correlated with depression, and the lower the nurse's education, the more severe the depression, contrary to the findings of Prasetyo et al. (31). The lack of a comprehensive analysis of the condition and problems of COVID-19 critically ill patients at a low level of education may reduce their professional values and professional identity and lead to depression (32). ICU nurses with bachelor's degree or above have better comprehensive quality and thinking ability than those with junior college degree or below. They have systematic learning ability of ICU specialized knowledge and skills, strong understanding and thinking ability, and have strong basic skills to deal with work difficulties. These factors make them actively adopt COVID-19 knowledge. In the treatment of critically ill patients with COVID-19, positive attitude and high stress resistance had little effect on mental health (33). The critical factor is the emergency deployment of human resources to support the ICU. Psychologists should be invited to provide psychological counseling for ICU nurses with low academic qualifications to improve their mental health status (34). At the same time, stratified training and education should be provided for nurses at all levels to improve their professional skills (35), provide opportunities and platforms for personal development, enhance nurses' sense of self-worth and professionalism, and improve their working conditions (36).

In conclusion, during the COVID-19 pandemic, stress perception score, work experience in critical care and education background were important factors affecting the occurrence of depression in ICU nurses. Medical institutions should timely understand the depression of ICU nurses and carry out targeted psychological interventions to avoid severe post-traumatic stress disorder in the future (37). Limitations of this study: First, since "Questionnaire Star" is not a field survey, respondents can freely fill in the questionnaire without signature, so it is impossible to check and evaluate the authenticity of the information obtained. Second, the sample size of the study is insufficient, which does not involve multi-center research and has limited representativeness. In the future, the scope of the study can be expanded to formulate intervention models in line with professional characteristics.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of Beijing Ditan Hospital Capital Medical University (2020–023–01). Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

JL and YZ: substantially contributed to conception or design. YH: contributed to acquisition, analysis, or interpretation of data. JL and YB: drafted the manuscript for important content. LL and WY: critically revised the manuscript for important intellectual content. All authors gave final approval of the manuscript.

ACKNOWLEDGMENTS

The authors would like to thank ICU nurses for excellent support and Professor Jingyuan Liu for critically reviewing the manuscript.

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Case Report: COVID-19 Infection With Gastrointestinal Symptoms and Mood Disorder: Criticalities in Differential Diagnosis, Therapy and Management of Complications

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OPEN ACCESS

Edited by:

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Specialty section:

This article was submitted to
Mood Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 01 June 2020

Accepted: 08 November 2021

Published: 10 December 2021

Citation:

Borriello G, Lavatelli L, Ruzzi F,
Panariello A and Percudani ME (2021)
Case Report: COVID-19 Infection With
Gastrointestinal Symptoms and Mood
Disorder: Criticalities in Differential
Diagnosis, Therapy and Management
of Complications.
Front. Psychiatry 12:568553.
doi: 10.3389/fpsy.2021.568553

During this pandemic Italy was deeply hit by the burden of the COVID-19. Current studies reveal that respiratory symptoms of COVID-19 represent the most common manifestations at presentation. The incidence of less common gastrointestinal symptoms varies significantly among different study populations. Liver injury is also described at different degree. We describe the case of a 20-year-old woman confirmed as SARS-CoV-2 positive by nasopharyngeal swab-PCR test, admitted to the COVID-only—Psychiatric Ward, set up in Niguarda Hospital in Milan on March 2020, for a depressive episode characterized by depressed mood and anorexia. In comorbidity we report a previous avoidant/restrictive food intake disorder present since childhood and a Border Personality Disorder according to the DSM V. On the admission to the ward we administered the Hamilton Depression Rating Scale with a total score of 29 suggesting severe depression. During the hospitalization she developed a clinical picture with increasing vomiting and diarrhea, nausea, abdominal pain along with fever and no respiratory symptoms. She also showed abnormalities in liver function indices. At the same time she showed clinophilia and persistent food avoidance that, initially, led to attribute all the symptoms to her psychiatric disorders. We prescribed the already ongoing therapy with lithium carbonate and SSRI. On the second day of hospitalization, along with the worsening of the gastrointestinal symptoms, we started therapy with hydroxychloroquine with a no significant remission of nausea and vomiting but with a further increase in liver function indices suggesting liver damage. This led us to suspend the treatment with hydroxychloroquine for the suspect of a drug induced injury. The depressive symptoms improved rapidly as opposed to the patient's overall condition. The gastrointestinal symptoms resolved with the evidence of the recovery from infection. In this report we underline the importance of investigating the physical symptoms in a patient with a history of mental disorder especially during an undergoing pandemic. During this pandemic,

specialists from various fields were called upon to support teams working with COVID patients and to acquire new skills out of necessity, fostering a multidisciplinary approach and cooperation.

Keywords: gastrointestinal, liver injury, mood disorder, COVID pandemic, eating disorder

INTRODUCTION

On March 11th 2020 WHO defined COVID-19 as a pandemic. The outbreak began in Wuhan in China in December 2019 and rapidly spread around the world. Italy has been deeply hit by the COVID-19 epidemic, especially in the Northern regions. In Italy 204,000 cases and 27,682 deaths were registered until April 30th. In Lombardy alone, as of this writing, there are 75,732 confirmed cases, with a total of 13,772 deaths¹.

Ongoing studies have shown that respiratory symptoms of COVID-19 such as fever, dry cough up to dyspnea represent the most common manifestations of the disease, and that are strongly indicative of a transmission of the infection by droplets and by contact². The incidence of gastrointestinal symptoms like diarrhea, nausea, vomiting, and abdominal discomfort is less common and varies significantly between different study populations, along with an early and mild onset frequently followed by the appearance of typical respiratory symptoms (1). Anosmia has also been reported (2).

SARS-CoV-2 attacks the respiratory system as a preferential site, specifically the pulmonary alveoli by binding to ACE2 receptor (3). It showed tropism for various organs including above all heart, kidneys, brain and the gastrointestinal system, especially liver and pancreas (4). This picture is most likely attributable to the ubiquitous distribution of angiotensin-converting enzyme 2 (ACE2). Hepatic involvement is not a major manifestation of COVID-19, it is not yet clear what impact this has on the prognosis of these patients (5).

During COVID-19 outbreak, psychiatric services in Lombardy have been working to guarantee continued services at both a residential and community level, guaranteeing hospitalization for acute cases infected by SARS-CoV-2 (6). The Niguarda Hospital in Milan, has dedicated psychiatric ward for COVID-19 positive patients with acute psychiatric disorders. A local protocol for treatment of psychiatric patients positive for COVID-19 was implemented. Infectious Diseases Unit carried out an initial assessment, providing therapeutic and diagnostic indications, and daily follow-up consultations with 24 h availability. Intensivists visited patients in hospital to evaluate eligibility for therapeutic upgrade; immediately reporting clear evidence of interstitial pneumonia with respiratory distress defined as breath rate >30 acts/minute, SpO₂ <93–92%, or when the PaO₂/FiO₂ ratio of <300 mmHg on blood gas analysis. Hospitalization in the intensive care-unit (ICU) was provided for patients with severe respiratory distress or additional severe COVID-19 symptoms. From March 9th to April 30th 2020, 24

COVID-19 positive patients with acute psychiatric disorders were hospitalized (14 M, 10 F; mean age 41 years; 6 Psychoses, 3 Bipolar disorders, 7 Depressive disorder, 4 Personality disorders; 2 Cognitive disorder; 2 Intellectual disability). None of these had relevant gastrointestinal or hepatic diseases in previous medical history.

Among our patients, a 20-year-old woman reported a prevalent gastrointestinal symptomatology and an important increase in liver function indices in the absence of involvement of the respiratory system. The clinical case we will examine highlights complex problems of differential diagnosis with the main psychiatric disease, critical issues in therapy and in the management of complications that occurred during treatment.

CASE PRESENTATION

The 20-year-old female patient accessed our ward for a picture compatible with recurrent depressive episode in personality disorder. In the days preceding the hospitalization, the patient had visited the general Emergency Department twice reporting fever (max body surface temperature 38°C). Upon entry to the ward, a nasopharyngeal swab test was performed for COVID-19 which tested positive. Anamnesis reports a history of a food intake disorder (restrictive behaviors) (7) present since childhood and a comorbid diagnosis of Border Personality Disorder (8). The patient is known for prior hospitalizations in our ward for depressive symptoms, self-injurious behaviors, hypo/anorexia.

On admission, a psychopathological picture was highlighted, characterized by a marked deflection of mood tone, asthenia, hypo/anorexia, self-injurious ideation, insomnia, overall psychomotor slowing. In the days preceding the hospitalization she had been practicing self-cutting on the left forearm which was being medicated.

In order to complete the psychopathological diagnostic assessment, the Hamilton Depression Rating Scale (9) was administered with a score of 29 suggesting severe depression.

Upon admission to ward, parameters were measured: the patient was paucisymptomatic, with febricula (up to 37.6 °C), oxygen saturation (SpO₂) of 100%. Laboratory parameters, in particular complete blood count, liver, kidney and thyroid function indices, coagulation, lipidic and glucidic profile were within normal ranges, with the exception of a modest increase in PCR (3.9) and a mild hypoalbuminemia (3.35 as compared to normal range of 4.02–4.76).

During the hospital stay, as per hospital protocol, vital signs were measured daily, 3 times a day (Blood Pressure, Heart Rate, Respiratory Rate, SpO₂, Body Temperature) and blood chemistry tests were carried out every 72 h to monitor SARS-CoV-2 infection, especially blood count with formula, AST,

¹<https://www.epicentro.iss.it/coronavirus/aggiornamenti>

²<https://www.who.int/news-room/commentaries/detail/modes-of-transmission-of-virus-causing-covid-19-implications-for-ipc-precaution-recommendations>

TABLE 1 | Trend of the main health parameters (body temperature, oxygen saturation, heart rate, body weight).

Nasopharyngeal swab-PCR test	Body temperature	Oxygen saturation	Heart rate	Body weight
Positive (16/03)	37.6	99	102	65
Weak positive (02/04)	37	100	100	64.2
Negative (15/04)	36.7	99	70	63.1
Negative (18/04)	37.1	98	79	62.8
Negative (20/04)	36.8	100	56	62.5

ALT, total and esterified bilirubin, alkaline phosphatase, LDH, electrolytes, creatinine, urea, urate, Pro-BNP, Pro calcitonin, fibrinogen, PT, PTT, D-dimer, glycaemia, CRP, SPE (**Table 1**). To complete the diagnostic framework, a high-resolution chest CT scan was also performed which did not show characteristic findings for COVID-19.

Two days after admission, the patient began to show a symptomatology of nausea, vomiting and loss of appetite; the latter was reported also during the previous hospitalizations. She also had bouts of diarrhea. In the last 2 years, the patient had 5 ordinary hospitalizations in our ward, during which an established relational pattern emerged, characterized by a regressive behavior with restricted eating behaviors and self-induced vomiting together with depressive symptoms.

In the first phase of hospitalization, we prescribed the ongoing psychopharmacological therapy with lithium carbonate (600 mg daily) and benzodiazepines and we started the administration of slow titration SSRI (sertraline). Monitoring of blood chemistry tests showed a progressive increase of AST, ALT e GGT (**Figure 1**) compared to the beginning when the nasopharyngeal swab tested positive for SARS-CoV-2.

On the 2nd day of hospitalization, a consultation was carried out with the infectious disease specialist who suggested to introduce an experimental therapy based on hydroxychloroquine with an initial loading dose of 800 mg/day for the first day, and then 400 mg/day on the following days, for a total of 10 days.

Due to a significant increase in AST (97 U/L) and ALT (362 U/L) levels along with a moderately increased gamma-GT values (66 U/L) further laboratory investigations were needed to search for the antigens of the main hepatotropic viruses that were absent. Hydroxychloroquine therapy was suspended on 2/4/2020, one week after it was started.

Furthermore, the execution of an abdominal ultrasound did not show morphological and structural alterations of the liver and biliary tract; finally, a parasitological examination was carried out on the stool, which was also negative on three samples. The consultation with the hepatologist confirmed the presence of drug-induced liver disease rather than a direct damage from SARS-CoV-2.

There was a weight loss of about 7 kg in 2 weeks with a change in the BMI from 24.22 to 21.8. The EDI-2 (10) was administered

TABLE 2 | Eating disorder inventory.

EDI-2 subscales	
Ascetism	7
Body dissatisfaction	9
Bulimia	0
Drive for thinness	14*
Interpersonal distrust	16*
Impulse regulation	16*
Ineffectiveness	19*
Interceptive awareness	6
Maturity fears	19*
Perfectionism	0
Social insecurity	13*

*** refers to the EDI subscales in which the patient scored significantly.

(**Table 2**) which revealed a significantly altered score in the Inadequacy (19) and Maturity fears (19) subscales.

We observed a more rapid remission of the psychopathological picture as compared to the gastrointestinal picture and to the general clinical conditions, with regression of self-injurious thoughts and a stabilization of the dysthymia toward euthymia.

Two weeks after the diagnosis of SARS-CoV-2 infection, the nasopharyngeal test was repeated and was still weakly positive; subsequently, the test was repeated after a week and proved negative, and this result was confirmed by another molecular test on nasopharyngeal swab at 24 h. With the resolution of the infection, there has been a progressive improvement of gastro-intestinal symptoms with the patient gradually starting to ingest food. Despite this, the liver function indices remained altered even at the end of the hospitalization, 35 days after the entry/admission and after the positivity to SARS-CoV-2 was detected, with ALT values equal to 434 U/L and AST values equal to 90 U/L, so much so that an outpatient hepatological follow-up at our hospital was required.

DISCUSSION

In the first place this case history raises questions regarding differential diagnosis. The overlapping of psychopathological symptoms with the gastrointestinal manifestations of COVID-19, subject to ongoing examination, have made both diagnosis and treatment complex. Administering the EDI-2 consisting of 91 questions divided into 11 subscales, enabled us to exclude a concomitant eating disorder in the patient, despite her medical history showing a predisposition, above all in new acute phases of depression, for restrictive food intake and self-induced vomiting. The subscales in which she scored significantly were those of “drive for thinness”, “interpersonal distrust”, “impulse regulation”, “social insecurity”, “maturity fears” and “inadequacy”. The patient scored highest (19) on the latter two subscales. Total scoring may be related to the

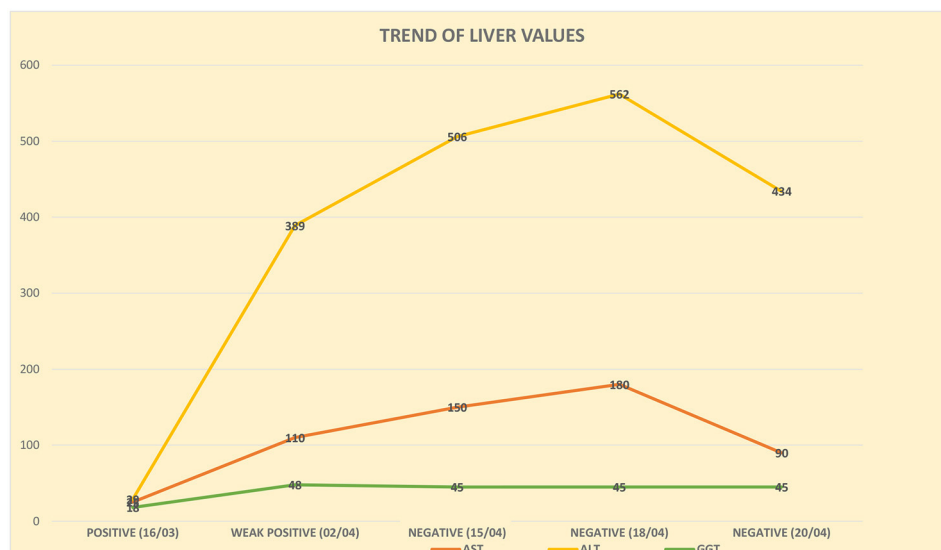


FIGURE 1 | Trend of liver values.

personological pattern associated with the patient's Borderline Personality Disorder, marked by poor self-image, feelings of uselessness, emptiness, inadequacy and lack of control over relational dynamics, associated with a tendency to regress and shelter behind childish behaviors due to a fear of maturity. Moreover, these characteristics correspond to clinical elements already highlighted during previous hospital stays.

As further evidence of the correlation of gastrointestinal symptoms with a SARS-CoV-2 infection we note that psychopathological symptoms improved rapidly as opposed to the patient's overall condition. The patient manifested a regression of self-harm ideation and a clear improvement of her dysthymia prior to the remission of nausea, vomiting and diarrhea, to the point that her hospital stay was extended to 4 weeks in order to cure the infection. When the patient entered the ward we were also able to ascertain the presence of a depressive episode by means of the Hamilton D evaluation scale. We chose HRSD supposing that physical symptoms were linked with depressive episode as previously observed.

The patient was put on a course of slow titration SSRI antidepressants so as not to worsen her gastrointestinal symptoms.

Implementing hospital protocol for cases testing positive for Sar-Cov2 enabled a close monitoring of blood chemistry tests considered to be useful in controlling the development of COVID-19. The discovery of significantly altered liver function made the treatment of the infection critical, requiring greater caution with regard to the titration of the antidepressant drugs prescribed.

One problem we faced was discriminating between potential liver damage caused by SARS-CoV-2 and iatrogenic damage caused by hydroxychloroquine used experimentally to modulate

the inflammatory response to the infection, or both mechanisms. The persistence of gastrointestinal symptoms, already evidenced from the second day of hospitalization on our ward, despite treatment with hydroxychloroquine, led us to suspend this treatment after a week on the advice of the infectious diseases specialist. Subsequently, we witnessed a clinical improvement with the patient gradually starting to ingest food and a cessation of nausea and vomiting after meals. Two days after this improvement a nasopharyngeal swab proved negative. Following this result we were inclined to see a close correlation between viral load negativization and the improved clinical picture.

The infectious diseases specialist speculated that treatment with hydroxychloroquine caused the iatrogenic damage previously documented in the literature and that the same treatment used as preventive medicine for COVID-19 was of dubious efficiency (11). Nowadays the use of hydroxychloroquine in COVID-19 is not recommended (12).

In our case study other specialists excluded the direct liver damage by SARS-CoV-2 which is not confirmed even by recent studies that recommend to better investigate the causes of liver injury in patients with COVID-19 and the effect of treatment for COVID-19 on the liver (13).

We had a constant dialogue with the patient and her family. Management of side effects complicated hospital admission, prolonged the hospital stay and determined careful handling of the patient relationship and relations with family members.

CONCLUSIONS

The current health emergency has severely impacted the Italian National Health Service and necessitated a reorganization of

Mental Health Services and Facilities in order to meet social distancing requirements and to curb the spread of the epidemic. In our case it has proved necessary to set up a SPCD COVID ward dedicated to accommodating patients with acute disorders who have been tested molecularly.

It is well-known that access to general health services on the part of psychiatric patients is restricted and that often symptoms manifested by patients are underrated and attributed to their history of psychiatric disorders. In our case too, the patient visited Accident and Emergency twice in the days leading up to her admission manifesting a fever which was noted in her medical history. The patient only underwent a diagnostic test for SARS-CoV-2 upon entry to the SPCD. These circumstances led us to urge Emergency Services to carry out a more attentive evaluation of psychiatric patients as a piece of an overall picture taking into account general health and correlated COVID-19 symptoms in a population of fragile and complex patients who are also at greater risk due to a high frequency of unpredictable and promiscuous behaviors.

This case history refocuses attention on the importance of psychiatric medical history, the correct use of evaluation scales complementary to a diagnosis, especially where it is difficult to establish a differential diagnosis, prescription of treatment and management of complications. In this case report we suggest to test the patient with specific scales in order to make a differential diagnosis between gastrointestinal COVID-19 and eating disorder.

During this pandemic, specialists from various fields were called upon to support teams working on wards reserved for

COVID-19 patients. There was a clear need to acquire new skills and to provide a clinical multidisciplinary evaluation by administering both psychological and laboratory tests.

We were in the first critical phase of the pandemic and at that time it has been very difficult to deal with patients with undergoing infection and the presentation symptoms widely recognized were respiratory. Gastrointestinal symptoms and hepatitis were still being studied.

The main limitation of this paper is the only one case report in our experience in the first pandemic period. It's important to add other similar cases to improve our skills to recognize covid symptoms between psychiatric symptoms and drug side effects (i.e., Hydroxychloroquine).

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

ACKNOWLEDGMENTS

We thank Dr. Martina Sommariva, Language Specialist, for the support.

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