

Coping with pandemic and infodemic stress: A multidisciplinary perspective

Edited by

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Coping with pandemic and infodemic stress: A multidisciplinary perspective

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Dynamics of Perceived Positive Changes and Indicators of Well-Being Within Different Phases of the COVID-19 Pandemic

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Background: During the COVID-19 pandemic, people reported about fears, depressive states, and phases of loneliness. However, there have also been positively experienced changes in terms of awareness of nature, reflection of life, more intensive relationships, meaningful digital media usage to connect with others, and interest in spirituality. We were interested in the dynamics of these indicators directly after the first lockdown, the summer months and during the second wave of the pandemic with its second lockdown, and how they relate to the perceived restrictions, fears, and worries.

Method: Survey with standardized questionnaires, i.e., Perceived Changes Questionnaire, WHO-Five Well-being Index, Brief Multidimensional Life Satisfaction Scale, Awe/Gratitude scale. Participants were categorized as cohort 1 (June 2020; $n = 1,333$), cohort 2 (July to September 2020, $n = 823$), and cohort three (October 2020 to January 2021, $n = 625$).

Results: Participants perceived changes in specific attitudes and behaviors, which have impacted their well-being and life satisfaction. Compared to their experiences directly after the first wave of the pandemic (cohort 1), well-being (Hedge's $g = 0.83$) and life satisfaction ($g = 0.63$) decreased during the second wave (cohort 3) and participants' stressors increased ($g = -0.94$). At the same time, positive perceptions such as Nature/Silence/Contemplation ($g = 0.67$), Spirituality ($g = 0.62$), Relationships ($g = 0.55$), and Digital media usage declined ($g = 0.31$), but not Reflections on life ($g = -0.03$). In cohort 3, the proportion of persons relying on their faith as a strong hold was declining also in nominally religious persons. Awe/Gratitude was among the best predictors of perceived positive changes, indicating a resource which is nevertheless declining during the second wave of the pandemic ($g = 0.60$).

Conclusions: Several perceptions, attitudes, and behaviors have changed, particularly during the second wave of the pandemic, which had a strong influence on psychological health. Although Awe/Gratitude was confirmed as the best predictor of perceived positive

changes, this resource may not buffer against the negative outcomes of the pandemic but helps to recognize the still positive aspects in life. There is a need for new and not yet defined public health communities that could focus on persons which are affected in their physical, mental, social, and spiritual health and well-being due to the pandemic.

Keywords: coping with pandemic stress, perceived changes, well-being, spirituality, COVID-19 pandemic

INTRODUCTION

During the COVID-19 pandemic, many people have experienced difficult times of social isolation and anxieties about getting infected and suffering from complicated courses of disease (1–4), while others did not share these experiences and ignored social restrictions (5). Although the strategies to cope with the pandemic are in fact heterogeneous (6), one can state that within the general population increased levels of pandemic related stress, anxiety, and depression have been prevalent (7–9). In several cases, persons' mental health deteriorated during the pandemic (10), and others had indicators of "defeat stress" (11). Generally, persons at risk were in fear of the COVID-19 infection and had lower quality of life, e.g., tumor patients (1–4) or pregnant women (12). In adolescents and young adults, it was found that restricted relationships resulted in an increase of negative affect, while loneliness impaired their mental health (9, 13). In Italy, adolescents had a "low perception of risk of COVID-19" during the first wave of the pandemic, while they nevertheless consented that the recommended restrictions may protect others (14). Another important finding of this study was that female students and adolescents living in more severely affected regions "showed more significant psychological negative feelings about the quarantine experience" (14).

Apart from the obvious negative outcomes of the pandemic, there are also reports of positively experienced changes in attitudes and behaviors, particularly in terms of (1) Nature/Silence/Contemplation, (2) Spirituality, (3) Relationships, (4) Reflection on life, and (5) Digital media use (4). These changes were more intensely observed in the elderly, persons with higher well-being, and people who were able to rely on their faith as a resource to cope (4). The best predictor of most of these changes has been the ability to stop in wondering awe in certain situations (these are often related to nature) with subsequent feelings of gratitude (4). These perceived changes can be related to the concept of posttraumatic growth. This implies that in difficult life situations people may perceive differently and change their attitudes and behaviors, i.e., in terms of positive affect, personal strength, appreciation of life, changed priorities, more intimate relationships, prosocial behaviors, and spiritual development (15–17). This change is not simply a buffer against harm (in terms of resisting these afflictions), but a resilient process of change and of finding meaning in trauma and development (in terms of reappraisal coping). In a similar way, adaptation processes related to the COVID-19 pandemic may result in processes of inner change, as found in the above mentioned perceptions directly after the first lockdown in 2020 (3, 4).

During the summer months of 2020, following the COVID-19 outbreak and first lockdown restrictions, the number of infected and dying persons was decreasing and several restrictions were stopped step by step. In consequence, social distancing and wearing protection masks were practiced less often. Perceived stress declined in this period, and more emotional stability was observed (18). A small though loud fraction of the population protested publicly against the necessity of the official protection measures (19–21), and an optimism bias related to less engagement in behavior changes arose (22). This could be seen as an attempt to protect autonomy in an uncontrollable situation—and accepting the risk to infect others. Thus, the social situation is complex and often contradictory.

During October 2020, however, the number of infected persons was increasing quickly again, and a second lockdown followed in Germany in December 2020 to control the strongly growing numbers of hospitalized patients and persons dying from the COVID-19 infection. Actually, during September and October 2020, it became clear that a second wave of the COVID-19 pandemic started which would be even stronger than the first one. How were people affected by this dramatic development of the pandemic, and how did they cope or change their behaviors—how did they react mentally, emotionally, spiritually? How would these changes compare with the ones perceived in the first wave? To answer this, we analyze the dynamics and interactions of fears and worries, well-being and stressor, and perceived changes in attitudes and behaviors due to the pandemic. Participants of the ongoing survey were categorized due to their survey entry in June 2020 (cohort 1, directly after the first lockdown), during the summer months July to September 2020 (cohort 2), and October 2020 to January 2021 (cohort 3, including the lockdown months December 2020 and January 2021).

MATERIALS AND METHODS

Recruitment of Participants

Participants were recruited via snowball sampling in different networks in Germany, i.e., university students and staff, research collaborators, religious orders and church communities, Rotary Club members, Facebook sites, private websites of public persons, etc., starting in June 2020. In addition, all were invited to spread the information about this survey in their personal networks, too.

Participants were assured confidentiality, were informed about the purpose of the study, and were provided data protection information at the starting page of the online survey. By filling in the anonymous questionnaire, interested persons consented to participate. Neither identifying personal details nor IP addresses were recorded to guarantee anonymity.

Measures

Perception of Changes

To assess which changes of attitudes, perceptions, and behaviors due to the Corona pandemic were observed by the participants, we used the 32-item Perception of Change Questionnaire (PCQ), with has good psychometric properties (Cronbach's $\alpha = 0.91$) (4). The instrument differentiates five main factors: (1) Nature/Silence/Contemplation (seven items, Cronbach's $\alpha = 0.87$); (2) Spirituality (five items, Cronbach's $\alpha = 0.83$); (3) Relationships (six items, Cronbach's $\alpha = 0.80$); (4) Reflection on life (three items, Cronbach's $\alpha = 0.74$); (5) Digital media usage (three items, Cronbach's $\alpha = 0.74$), and an additional three-item factor termed Restrictions (Cronbach's $\alpha = 0.78$) (4). The internal consistency of the respective factors in this sample is partially better than in the validation sample (Cronbach's α s = 0.88, 0.86, 0.84, 0.74, 0.77, and 0.83).

The items were introduced by the phrase "Due to the current situation..." which referred to the COVID-19 pandemic. Representative items are "I pay more attention to what's really important in life," "I perceive the relationship with my partner/family more intensely," "I perceive nature more intensely," "I am more concerned about the meaning and purpose of my life," and "I have confidence in a higher power that supports me." Agreement or disagreement was scored on a five-point scale (0—does not apply at all; 1—does not truly apply; 2—neither yes or no; 3—applies quite a bit; 4—applies very much).

Well-Being

To assess participants' well-being, we used the WHO-Five well-being Index (WHO-5) (23). Representative items are "I have felt cheerful and in good spirits" or "My daily life has been filled with things that interest me." Respondents assess how often they had the respective feelings within the last 2 weeks, ranging from "at no time" (0) to "all of the times" (5). Here we report the sum scores ranging from 0 to 25. Scores <13 would indicate reduced well-being or even depressive states. In comparison, the alternative WHO-5 sum scores referred to a 100% level [0–100], which is also used in literature, scores <50 are indicative for reduced well-being, while scores < 28 are indicative for clinical depression (24). The internal consistency of this well-established instrument in this sample is very good (Cronbach's $\alpha = 0.91$).

Life Satisfaction

Life satisfaction was measured using the Brief Multidimensional Life Satisfaction Scale (BMLSS) (25). The items of the BMLSS address intrinsic (oneself, life in general), social (friendships, family life), external (work situation, where one lives), and prospective dimensions (financial situation, future prospects) of life satisfaction as a multifaceted construct. All items were introduced by the phrase "I would describe my satisfaction with ... as". Scoring ranges from very dissatisfied (0) to very satisfied (6). The internal consistency of the instrument was found to be good in the validation study (Cronbach's $\alpha = 0.87$). In this study, the 10-item version was employed that includes satisfaction with the health situation and abilities to deal with daily life concerns (BMLSS-10). The instruments' internal consistency is good in this sample, too (Cronbach's $\alpha = 0.86$).

We further addressed participants' satisfaction with support by religious community with the same scoring.

Perception of Burden

Perceived restrictions of daily life, of being under pressure/stressed, anxiety/insecurity, loneliness/social isolation, and restrictions of financial-economic situation due to the corona pandemic were measured with five numeric rating scales (NRS), ranging from 0 (not at all) to 100 (very strong) as described (4). These five variables can be combined to a factor termed "Stressors" (5NRS) with good internal consistency (Cronbach's $\alpha = 0.80$). The instruments' internal consistency in this sample is good, too (Cronbach's $\alpha = 0.82$).

Indicators of Spirituality

Perceptions of wondering awe and subsequent gratitude is a perceptive aspect of spirituality which is also relevant to less or non-religious persons (26). To address times of pausing for astonishment or "wonder" in specific stations (mainly in the nature), we measured perceived awe and subsequent feelings of gratitude as a perceptive aspect of spirituality with the seven-item Awe/Gratitude scale (GrAw-7) (26). This scale has good psychometric properties (Cronbach's $\alpha = 0.82$) and uses items such as "I stop and then think of so many things for which I'm really grateful," "I stop and am captivated by the beauty of nature," "I pause and stay spellbound at the moment," and "In certain places, I become very quiet and devout." Thus, Awe/Gratitude operationalized in this way is a matter of an emotional reaction toward an immediate and "captive" experience. All items were scored on a four-point scale (0—never; 1—seldom; 2—often; 3—regularly) and finally transferred to a 100-point scale. The instruments' internal consistency in this sample is good (Cronbach's $\alpha = 0.86$).

To measure also more specific forms of religiosity, we added item A37 from the Reliance on God's Help scale (27), which asks whether faith is a strong hold in difficult times. Agreement or disagreement was scored on a three-point scale (0—disagreement; 1—indifference; 2—agreement). This item was used as a differentiating variable to assess intrinsic religiosity in terms of an attitude.

The frequency of spiritual/religious practices such as meditating or praying was assessed with a 4-grade scale ranging from never, to at least once per month, at least once per week, and at least once per day as described (4).

Corona Pandemic Irritations

Several persons reported that they were "Irritated or unsettled by different statements about the danger and the course of the corona infection in the public media" (1, 3). Agreement to this statement was scored from not at all, a little, somewhat, to very much.

Frequency of Physical Activity

Health behaviors such as physical activity/sporting and walking outside in the nature were measured with a four-grade scale (never, at least once per month, at least once per week, at least once per day) as described (4).

Statistical Analysis

Descriptive statistics for demographic variables and for factors are presented as frequencies for categorical variables and as mean ($\pm$ standard deviation, SD) for numerical variables. Between-group comparisons for categorical variables were performed with Pearson's χ^2 Independence Test and for numerical variables with the non-parametric Mann-Whitney- U hypothesis test. Analyses of variance (ANOVA) and linear regression analyses

with stepwise variable selection based on probabilities were computed with SPSS 23.0. Given the exploratory character of this study, we set a stricter significance level at $p < 0.001$ (28).

A post hoc power analysis (G*Power 3.1.9.7) was performed to evaluate the significance and power of the statistical analysis. Given the final sample size, the three time measurement periods (three cohorts) considering the alpha level at 0.05, and an overall medium effect size $f = 0.25$, we were able to achieve a post hoc

TABLE 1 | Description of the samples ($N = 2,781$).

	Participants Cohort 1 (June)	Participants Cohort 2 (July to September)	Participants Cohort 3 (October to January)	All participants	p-values (Pearson's χ^2) (Mann-Whitney- U test)
Proceeding participants (n)	1,333	823	625	2,781	
Mean age (years)	48.9 $\pm$ 14.1	47.4 $\pm$ 13.0	42.7 $\pm$ 14.4	47.1 $\pm$ 14.1	<0.0001
Gender (%)					n.s.
Women	66.4	69.9	66.4	67.4	
Men	33.6	30.1	33.6	32.6	
Family status (%)					n.s.
Living alone	22.3	21.3	18.9	21.2	
Other forms	77.7	78.7	81.1	78.8	
Religious affiliation (%)					<0.0001
With	78.8	78.0	59.7	74.3	
Without	21.1	22.0	40.3	25.7	
Faith as a strong hold (%)					<0.0001
No	27.0	27.2	53.5	33.1	
Indifferent	31.3	30.3	23.1	29.1	
Yes	41.8	42.5	23.4	37.8	
Satisfaction with support by religious community (0–6)	3.05 $\pm$ 1.22	2.98 $\pm$ 1.27	2.68 $\pm$ 1.44	2.96 $\pm$ 1.29	<0.0001
Lost my faith (%)	2.8	3.7	14.7	5.4	<0.0001
COVID-19 testing (%)					<0.0001
Positively tested	0.7	1.0	4.0	1.5	
Negatively tested	11.2	19.9	28.5	17.4	
Not yet tested	88.3	79.8	67.5	81.1	
Irritated by statements about danger and course of the infection in public media (%)	16.9	16.0	18.4	17.0	n.s.
Not at all	37.2	34.1	21.3	32.7	<0.0001
A little	32.3	36.2	25.9	32.0	<0.0001
Somewhat very much	14.3	14.0	35.2	18.9	<0.0001
Well-being (%)					<0.0001
Low (WHO-5 scores < 13)	31.0	30.1	63.5	38.0	
Moderate (WHO-5 scores 13–18)	39.3	38.9	21.9	35.3	
High (WHO-5 scores > 18)	29.7	31.0	14.6	26.7	
Social isolation/loneliness (%)					<0.0001
No loneliness (scores < 10)	33.3	37.7	19.5	31.5	
Somewhat lonely (scores 10–50)	51.4	48.5	34.2	46.7	
Stronger loneliness (scores > 50)	15.3	13.9	46.2	21.8	
Health behavior (0–3)					
Frequency sporting activities	1.83 $\pm$ 0.90	1.74 $\pm$ 0.91	1.45 $\pm$ 1.05	1.72 $\pm$ 0.95	<0.0001
Frequency walks in nature	2.09 $\pm$ 0.74	2.03 $\pm$ 0.76	1.94 $\pm$ 0.92	2.04 $\pm$ 0.79	0.002
Frequency meditation	1.20 $\pm$ 1.19	1.02 $\pm$ 1.16	0.63 $\pm$ 1.01	1.02 $\pm$ 1.16	<0.0001
Frequency praying	1.59 $\pm$ 1.29	1.49 $\pm$ 1.27	0.82 $\pm$ 1.19	1.40 $\pm$ 1.30	<0.0001

power of 1.00. In consequence, we can conclude that this data set is appropriate to perform such evaluations. Therefore, we are comfortable to draw the conclusions based on the data analysis.

There were some missing values in the variables with a maximum frequency of 2.6%. Since the percentage of missing data is low, multivariate imputation was applied using the Expectation Maximization (EM) method (29).

With respect to classifying the strength of the observed correlations, we adjusted the recommended thresholds (30) to $r > 0.5$ as a strong correlation, an r between 0.3 and 0.5 as a moderate correlation, an r between 0.2 and 0.3 as a weak correlation, and $r < 0.2$ as negligible or no correlation. Hedge's g effect sizes (31) and its confidence intervals (CI) were calculated with software R 4.0.3 package "effsize." Regarding Hedges' g , we used the following thresholds $g > 0.80$ large effect, g between 0.50 and 0.80 as medium effect, g between 0.20 and 0.50 as small effect, and $g < 0.20$ as negligible.

RESULTS

Description of the Cohorts

In this study, we enrolled participants from three time periods related to the COVID-19 pandemic: (1) persons directly after the first lockdown (June 2020; $n = 1,333$), (2) persons from the "delighted" summer months July to September 2020 ($n = 823$), and (3) persons at the start of the second wave of the pandemic (October to January, $n = 625$), which includes the second lockdown months December 2020 and January 2021.

Participants from these three cohorts did not significantly differ with respect to gender or family status, but they were younger ($\sim 12\%$ younger) in the 3rd cohort (Table 1). Moreover, in this 3rd cohort the proportion of persons without a religious affiliation was significantly higher ($\sim$ doubled), and the proportion of persons who rely on their faith as a "strong hold in difficult times" was lower ($\sim 44\%$ less), and the proportion of those who stated that they have lost their faith because of the pandemic was increasing, too (~ 5 times higher). Also, the satisfaction with the support by their local religious community (which was moderate) decreased significantly (Table 1).

Parallel to the number of infected persons in Germany which increased from October 2020 (31.5/100,000) to January 2021 (151/100,000), there was an increase of persons who are still "irritated by statements about danger and course of the infection in public media," who feel lonely and socially isolated, and who have lower well-being (Table 1).

The frequency of participants' sporting activities started to decline in cohort 2 [Hedges' $g = 0.10$ (0.01–0.19)] and was lowest in cohort 3 [Hedges' $g = 0.40$ (0.30–0.50)] (Table 1). The frequency of walking in nature was similar in cohorts 1 and 2 [Hedges' $g = 0.07$ (–0.01–0.16)] and declined in cohort 3 [Hedges' $g = 0.17$ (0.07–0.28)]. The frequency of meditation practices started to decline in cohort 2 [Hedges' $g = 0.15$ (0.06–0.24)] with a similar trend of praying [Hedges' $g = 0.08$ (–0.01–0.17)], while both spiritual practices were lowest in cohort 3 [Hedges' $g = 0.50$ (0.40–0.60) and $g = 0.61$ (0.51–0.72), respectively]. Thus, the decreases were moderate for meditating

TABLE 2 | Perceived changes in persons from cohorts 1–3.

		Perceived changes (PCQ)					
		Nature/Silence/Contemplation	Spirituality	Relationships	Reflection on life	Digital media usage	Restrictions
All participants	Mean	54.56	38.80	62.01	52.23	53.40	47.61
	SD	21.25	25.92	19.18	24.88	23.74	29.17
Cohort 1	Mean	58.49	43.56	64.99	52.48	56.07	42.70
	SD	20.07	25.25	17.99	24.73	22.85	26.54
Cohort 2	Mean	55.68	39.43	62.72	51.00	52.51	41.42
	SD	20.51	25.07	18.94	24.70	23.99	27.27
Cohort 3	Mean	44.70	27.83	54.71	53.32	48.87	66.24
	SD	21.60	25.19	20.06	25.41	24.54	29.30
F- value		97.5	83.4	64.7	1.7	20.7	186.9
p-value		<0.0001	<0.0001	<0.0001	n.s.	<0.0001	<0.0001
Hedges' d (CI)	Cohort 1 vs. 3	0.67 (0.57 to 0.77)	0.62 (0.52 to 0.72)	55 (0.45 to 0.65)	−0.03 (−0.13 to 0.06)	0.31 (0.21 to 0.40)	−0.86 (−0.96 to −0.76)

and praying and less than small for walking and a bit more only for sporting activities.

Perceived Changes in the Cohorts

There is constant decline of perceived positive changes, starting in the summer months, which was lowest in cohort 3, while perceived Restrictions were increasing in cohort 3 (Table 2). In the participants of the 3rd cohort, the scores of Nature/Silence/Contemplation and Digital media usage indicated that they were not perceiving the respective attitudes and behaviors anymore, while positive changes in terms of Spirituality were not generally perceived in cohort 1's participants and scored much lower now in cohort 3. Although positive changes of Relationships were declining, these are still positively perceived in cohort 3 (Table 2).

Because the proportion of persons lacking a religious affiliation was significantly higher in cohort 3, which cannot solely be attributed to the number of persons who have lost their faith because of the pandemic, we analyzed whether

or not religious and non-religious participants differ in their perceptions and behaviors within time. As shown in Table 3, non-religious persons of cohort 1 were scoring significantly lower for Spirituality than religious persons, and weakly lower also for Relationships, and for Reflection of life, but not for Nature/Silence/Contemplation, Digital media usage, or Restrictions. In cohort 2, perceived changes in Relationships scored much lower in non-religious compared to religious participants, and thus the difference in their scores is statistically significant. Interestingly, Spirituality scores decreased, too, in religious persons of cohort 2 and thus the differences between both groups are less pronounced than in cohort 1. In cohort 3, there is a decline of most perceptions in both groups, stronger though in non-religious persons (Table 3): perceived changes in Nature/Silence/Contemplation had become significantly different, while the previous differences for Spirituality and Relationships remained statistically significant. Thus, while the differences for Spirituality are not surprising, there are further differences within the course of time related to

TABLE 3 | Perceived changes in religious and non-religious persons differentiated within the three cohorts.

		Nature/Silence/ Contemplation	Spirituality	Relationships	Reflection on life	Digital media usage	Restrictions
All cohort 1 (<i>n</i> = 1,333)	Mean	58.49	43.56	64.99	52.48	56.07	42.70
	SD	20.07	25.25	17.99	24.73	22.85	26.54
Religious (<i>N</i> = 1,050, 79%)	Mean	58.80	47.03	65.63	53.33	56.57	42.90
	SD	19.65	24.03	17.48	24.18	23.00	26.25
Non-religious (<i>n</i> = 283, 21%)	Mean	57.33	30.69	62.57	49.35	54.21	41.96
	SD	21.56	25.53	19.59	26.48	22.25	27.62
F-value		1.20	100.4	6.49	5.78	2.28	0.28
<i>p</i> -value		n.s.	<0.0001	0.011	0.016	n.s.	n.s.
Hedges' <i>g</i> (CI)		0.07 (−0.06 to 0.20)	0.67 (0.54 to 0.80)	0.17 (0.04 to 0.30)	0.16 (0.03 to 0.29)	0.10 (−0.03 to 0.23)	0.03 (−0.10 to 0.17)
All cohort 2 (<i>n</i> = 823)	Mean	55.68	39.43	62.72	51.00	52.51	41.42
	SD	20.51	25.07	18.94	24.70	23.99	27.27
Religious (<i>N</i> = 642, 78%)	Mean	56.41	42.48	63.72	51.64	52.15	40.36
	SD	19.86	24.47	18.47	24.26	23.73	26.70
Non-religious (<i>n</i> = 181, 22%)	Mean	53.08	28.59	59.19	48.76	53.78	45.21
	SD	22.53	24.23	20.16	26.17	24.90	28.96
F-value		3.73	45.71	8.17	1.92	0.64	4.50
<i>p</i> -value		n.s.	<0.0001	0.004	n.s.	n.s.	0.034
Hedges' <i>g</i> (CI)		0.16 (−0.01 to 0.33)	0.57 (0.40 to 0.73)	0.24 (0.07 to 0.40)	0.12 (−0.05 to 0.28)	−0.07 (−0.23 to 0.10)	−0.18 (−0.34 to 0.01)
All cohort 3 (<i>n</i> = 625)	Mean	44.70	27.83	54.71	53.32	48.87	66.24
	SD	21.60	25.19	20.06	25.41	24.54	29.30
Religious (<i>N</i> = 373, 60%)	Mean	47.42	33.56	56.61	55.40	49.65	63.77
	SD	21.17	26.02	19.62	25.19	25.22	30.58
Non-religious (<i>n</i> = 252, 40%)	Mean	40.69	19.34	51.89	50.26	47.71	69.91
	SD	21.64	21.27	20.41	25.47	23.50	26.94
F-value		14.93	51.90	8.43	6.21	0.90	6.67
<i>p</i> -value		<0.0001	<0.0001	0.004	0.013	n.s.	0.010
Hedges' <i>g</i> (CI)		0.31 (0.15 to 0.47)	0.57 (0.42 to 0.75)	0.23 (0.07 to 0.40)	0.20 (0.04 to 0.36)	0.08 (−0.08 to 0.24)	−0.21 (−0.37 to −0.05)

Relationships in cohorts 2 and 3, and in cohort 3 also for Nature/Silence/Contemplation which can be attributed to stronger declines in non-religious persons.

We also asked whether participants fear for the future (additional item c28) and/or to have “hope that we (“afterwards”) as global mankind will pay more attention to each other” (additional item c25). Fear for future increased significantly ($p < 0.0001$, χ^2) from 29% (cohort 1) to 36% (cohort 2) and to 68% (cohort 3). In line with this increase of fear, participants’ hope for a more conscious global mankind decreased from 55 to 47% and finally to 28% in cohort 3; this decline is statistically significant ($p < 0.001$, χ^2). However, in the whole sample the motivation to start working to ensure that “the world becomes fairer in the future” (additional item c26) was stable in cohorts 1 and 2 (64% to 63%) and significantly ($p < 0.0001$, χ^2) decreasing in cohort 3 (48%).

Indicators of Quality of Life in the Three Cohorts

Along with the increase of infected persons from October 2020 to January 2021, there was a decrease of well-being, life satisfaction, and Awe/Gratitude in cohort 3 participants, while these variables had been quite stable in cohorts 1 and 2 (Table 4). Similarly, while the stressor scores were similar in cohorts 1 and 2, the stressors increased in cohort 3 participants. Detailed analyses revealed that the strongest increases were due to the perception of being restricted in daily life (which scored highest), of being under pressure, and the feeling of being lonely/socially isolated, while burdening financial situation (which scored lowest), and feelings of being under pressure/anxious were increasing less strongly (Table 4).

Again, we compartmentalized whether or not non-religious and religious participants from cohorts 1 to 3 differed with respect to their quality-of-life indicators. As shown in Table 5, at the end of the first lockdown (cohort 1), religious and non-religious persons’ scores of quality-of-life indicators were not that much different. During the summer months (cohort 2), non-religious participants’ life satisfaction and Awe/Gratitude scores started to decline, while these variables were similar compared to cohort 1 data in religious persons. Then in cohort 3, perceptions of both religious and non-religious persons changed similarly: particularly their life satisfaction decreased, and thus their scores did not differ significantly anymore. In addition, during the second wave of the pandemic, Awe/Gratitude decreased also in religious participants, although the difference between religious and non-religious participants remains statistically significant. However, well-being and life satisfaction of cohort 3 participants with or without a religious affiliation did not differ significantly and weakly only for the stressor scores.

To further clarify the impact of being non-religious on these variables, we also performed regression analyses. As shown in Table 6, both stressors and life satisfaction were predicted best by well-being, with only some marginal effects of age, gender, and being non-religious. The best predictor of Awe/Gratitude was well-being and gender, followed by age, and a further weak influence of being non-religious. Thus, being non-religious may

TABLE 4 | Stressors and indicators of quality of life in persons from cohorts 1 to 3.

		Restricted in daily life (NRS1)	Under pressure/stressed (NRS2)	Anxious/Insecure (NRS3)	Lonely/Socially isolated (NRS4)	Burdening financial situation (NRS5)	Stressors (5NRS)	Well-being (WHO-5)	Life satisfaction (BMLSS-10)	Awe/Gratitude (GrAw-7)
All participants	Mean	52.30	41.68	26.73	29.53	21.43	34.35	13.88	65.32	61.74
	SD	28.76	31.98	27.23	31.38	30.57	22.93	5.96	17.43	19.65
Cohort 1	Mean	47.50	35.52	23.39	24.51	17.88	29.76	14.96	67.93	64.89
	SD	25.96	29.29	24.01	27.35	27.50	20.00	5.26	15.58	17.98
Cohort 2	Mean	46.49	37.76	25.02	22.59	16.04	29.58	14.95	67.73	63.03
	SD	26.56	29.30	25.29	26.52	26.39	19.46	5.29	16.16	18.28
Cohort 3	Mean	70.22	60.19	36.16	49.56	36.13	50.43	10.16	56.55	53.31
	SD	30.04	33.98	33.39	36.74	36.78	25.60	6.65	19.79	22.28
F-value		176.1	148.6	50.7	185.1	100.5	231.0	176.9	110.0	80.8
p-value		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Hedges’ d (CI) cohort 1 vs. 3		-0.83 (-0.93 to -0.73)	-0.80 (-0.90 to -0.70)	-0.47 (-0.56 to -0.37)	-0.82 (-0.92 to -0.72)	-0.60 (-0.69 to -0.50)	-0.94 (-1.04 to -0.84)	0.83 (0.74 to 0.93)	0.67 (0.57 to 0.76)	0.60 (0.50 to 0.70)

TABLE 5 | Quality-of-life indicators in religious and non-religious persons differentiated within the three cohorts.

		Stressors (5NRS)	Well-being (WHO-5)	Life satisfaction (BMLSS-10)	Awe/Gratitude (GrAw-7)
All cohort 1 (<i>n</i> = 1,333)	Mean	29.76	14.96	67.93	64.89
	SD	20.00	5.26	15.58	17.98
Religious (<i>N</i> = 1,050, 79%)	Mean	29.17	14.96	68.29	65.05
	SD	19.21	5.23	14.98	17.97
Non-religious (<i>n</i> = 283, 21%)	Mean	31.96	14.92	66.59	64.30
	SD	22.58	5.40	17.59	18.03
F-value		4.37	0.01	2.65	0.39
<i>p</i> -value		0.037	n.s.	n.s.	n.s.
Hedges' <i>g</i> (CI)		−0.14 (−0.27 to −0.01)	0.01 (−0.12 to 0.14)	0.11 (−0.02 to 0.24)	0.04 (−0.09 to 0.17)
All cohort 2 (<i>n</i> = 823)	Mean	29.58	14.95	67.73	63.03
	SD	19.46	5.29	16.16	18.28
Religious (<i>N</i> = 642, 78%)	Mean	29.19	15.16	68.53	64.04
	SD	18.90	5.03	15.67	18.23
Non-religious (<i>n</i> = 181, 22%)	Mean	30.96	14.22	64.91	59.42
	SD	21.31	6.10	17.53	18.06
F-value		1.17	4.42	7.14	9.10
<i>p</i> -value		n.s.	0.036	0.008	0.003
Hedges' <i>g</i> (CI)		−0.09 (−0.26 to 0.07)	0.18 (0.01 to 0.34)	0.22 (0.06 to 0.39)	0.25 (0.09 to 0.42)
All cohort 3 (<i>n</i> = 625)	Mean	50.43	10.16	56.55	53.31
	SD	25.60	6.65	19.79	22.28
Religious (<i>N</i> = 373, 60%)	Mean	48.54	10.55	57.71	55.75
	SD	25.46	6.62	19.60	21.71
Non-religious (<i>n</i> = 252, 40%)	Mean	53.22	9.58	54.83	49.70
	SD	25.59	6.66	19.98	22.66
F-value		5.05	3.20	3.30	11.30
<i>p</i> -value		0.025	n.s.	n.s.	0.001
Hedges' <i>g</i> (CI)		−0.18 (−0.34 to −0.02)	0.14 (−0.01 to 0.30)	0.14 (−0.01 to 0.30)	0.27 (0.11 to 0.43)

TABLE 6 | Regression analyses with constant influencing variables age, gender, lack of religious affiliation, and well-being.

Dependent variables	Influencing variables	Beta	T	<i>p</i>
Stressors (5NRS) $R^2 = 0.43$ $F = 518.2, p < 0.0001$	(Constant)		46.436	<0.0001
	Age	−0.068	−4.547	<0.0001
	Gender	−0.038	−2.644	0.008
	No religious affiliation	0.055	3.820	<0.0001
	Well-being	−0.625	−41.806	<0.0001
Life satisfaction (BMLSS-10) $R^2 = 0.42$ $F = 483.9, p < 0.0001$	(constant)		32.996	<0.0001
	Age	−0.020	−1.322	0.186
	Gender	0.005	0.372	0.710
	No religious affiliation	−0.049	−3.325	0.001
	Well-being	0.641	42.297	<0.0001
Awe/Gratitude (GrAw-7) $R^2 = 0.20$ $F = 168.6, p < 0.0001$	(Constant)		28.323	<0.0001
	Age	0.176	9.925	<0.0001
	Gender	−0.213	−12.335	<0.0001
	No religious affiliation	−0.079	−4.600	<0.0001
	Well-being	0.321	18.074	<0.0001

have some small influence on a person's quality-of-life indicators but is not what mostly adds to the negative shifts in persons quality-of-life indicators.

Predictors of Perceived Changes

What are the predictors of the perceived changes (as dependent variables) due to the pandemic? To answer this question, we performed linear regression analyses with a stepwise selection method based on probabilities with the following influencing variables: age groups, well-being (WHO-5), life satisfaction (BMLSS-10), Awe/Gratitude (GrAw-7), Stressors (5NRS), loneliness/social isolation (NRS4), faith as a strong hold, meditation, and praying—and included the cohort as an influencing variable, too.

As shown in **Table 7**, the best predictors of Nature/Silence/Contemplation as dependent variable were Awe/Gratitude and meditation (which explained 24% of variance), followed by well-being (which added further 4%), and then cohort and Faith as a strong hold (which added 0.6% only, and are thus irrelevant).

The best predictors of Spirituality were praying and Faith as a strong hold (which together explained 53% of variance), followed by frequency of meditation and Awe/Gratitude (which add 6% of explained variance), and four further variables, among them cohort (which together added further 0.6% of explained variance and are thus irrelevant).

The Relationships factor was predicted best by Awe/Gratitude and life satisfaction (which explain 12% of variance), followed by cohort, Faith as a strong hold, and Stressors (which together added further 2%). However, this predictor model is quite weak ($R^2 = 0.17$) and findings may be seen as a hint only.

Reflection of life was predicted best by meditation, loneliness/social isolation, and Awe/Gratitude (which explained together 15% of variance), followed by six further variables, including being non-religious (which together explained further 5% of variance).

The predictor model of Digital media usage was much too weak ($R^2 = 0.06$) to rely on.

The best predictors of perceived Restrictions were Stressors and loneliness/social isolation (which explain 50% of variance), followed by four further variables, including cohort (which added 3% of explained variance).

DISCUSSION

Directly after the first lockdown which took about 3 months, people noticed also positive changes in their attitudes and behaviors. They were more aware of their relationships and intensified and valued them more than before, and they were more often outdoors for some walks, perceived nature more intensively, and consciously took more time for silence, enjoyed quiet times of reflection, were more attentive to what they deemed is really important in life, and used these extra times to reflect on meaning and purpose in life (4). This mindful approach to challenging life situations was shown to have a protective effect on health behaviors (32). To overcome social isolation, digital media usage was intensified to connect with friends and

to participate in the world via internet offers (4), while interest in spiritual issues was not intensified, apart from participants' high confidence in a "higher power" (God) that supports them. Further, participants stated they have hope that ("afterwards") we as global mankind will pay more attention to each other and stick together, and that they intend to start working to ensure that the world becomes fairer in the future (4). Awe/Gratitude, which addresses the ability to stop in wondering awe in specific situations with subsequent feelings of gratitude (26, 33), was the best predictor for most of these changes. This is a perceptive aspect of spirituality which does not necessarily require a religious denomination but is likewise experienced by people who would rather identify themselves as non-religious (33). Nevertheless, it indicates that a person's spirituality may influence their specific perceptions also in difficult times of a pandemic. Further, particularly the frequency of meditation practices (and praying) was related to Nature/Silence/Contemplation, indicating that contemplative/reflexive practices may sensitize for the awareness of specific perceptions (4). As these positively perceived changes were only to some extent related to well-being (weakly only to Nature/Silence/Contemplation), they might "represent an independent quality of relevance in their life" (4). A key issue will thus be whether the observed positive changes of attitudes and behaviors are short-term effects only or may help to cope with the further course of the pandemic in the long run, too.

Findings from the three cohorts analyzed herein indicate that several perceptions, attitudes, and behaviors have changed, particularly during the second wave of the pandemic: Participants' well-being and life satisfaction decreased and perceived burden ("stressors") increased; most perceived positive perceptions as well as health behaviors (sporting activities and walks in nature) and hope for positive changes have declined (**Figure 1**). These changes are embedded in the phenomena and consequences of societal disruption due to the public COVID-19 measures, as described analogously for the American society, including the high numbers of deaths, while expecting the second wave of autumn 2020: "The necessary social distancing and quarantine measures implemented as mitigation strategies have significantly amplified emotional turmoil by substantially changing the social fabric by which individuals, families, communities, and nations cope with tragedy. The effect is multidimensional disruption of employment, finances, education, health care, food security, transportation, recreation, cultural and religious practices, and the ability of personal support networks and communities to come together and grieve." (8). All of these elements will have their diffuse share in the perceived changes and in the decrease of participants' personal spiritual or religious practices.

Even though it may be true that walking in nature or sporting activities during late autumn and winter times (at the start of the second wave and its second lockdown) are not as attractive as in spring or summer time (directly after the first lockdown), and thus the frequency of engagement is slightly decreasing, it does not explain why also meditation practices and praying decreased in cohort 3, because these can be performed indoors, too, of course. A reason could be the larger fraction of non-religious persons in cohort 3, or a weakening of motivation and trust. Also

TABLE 7 | Predictors of perceived changes (stepwise regression analyses).

	Beta	T	p
Dependent variable: Nature/Silence/Contemplation Model 5: $F = 197.2$, $p < 0.0001$; $R^2 = 0.29$			
(Constant)		14.681	<0.0001
Awe/Gratitude (GrAw-7)	0.225	10.840	<0.0001
Meditation	0.209	10.607	<0.0001
Well-being (WHO-5)	0.188	9.938	<0.0001
Cohort	-0.089	-4.903	<0.0001
Faith as a stronghold	0.082	4.235	<0.0001
Dependent variable: Spirituality Model 8: $F = 439.2$, $p < 0.0001$; $R^2 = 0.59$			
(Constant)		2.742	0.006
Praying	0.328	17.302	<0.0001
Faith as a stronghold	0.315	16.739	<0.0001
Meditation	0.196	12.879	<0.0001
Awe/Gratitude (GrAw-7)	0.110	6.855	<0.0001
Loneliness/Social Isolation (NRS4)	0.058	3.933	<0.0001
Cohort	-0.064	-4.681	<0.0001
Life satisfaction (BMLSS-10)	-0.048	-3.087	0.002
Age groups	0.035	2.479	0.013
Dependent variable: Relationships Model 5: $F = 100.2$, $p < 0.0001$; $R^2 = 0.17$			
(Constant)		13.556	<0.0001
Awe/Gratitude (GrAw-7)	0.266	12.521	<0.0001
Life satisfaction (BMLSS-10)	0.170	7.225	<0.0001
Cohort	-0.112	-5.651	<0.0001
Faith as a stronghold	0.077	3.809	<0.0001
Stressors (5NRS)	0.076	3.301	0.001
Dependent variable: Reflections of life Model 9: $F = 71.0$, $p < 0.0001$; $R^2 = 0.21$			
(Constant)		8.223	<0.0001
Meditation	0.115	5.428	<0.0001
Loneliness/Social Isolation (NRS4)	0.168	6.374	<0.0001
Awe/Gratitude (GrAw-7)	0.241	10.686	<0.0001
Life satisfaction (BMLSS-10)	-0.136	-5.446	<0.0001
Praying	0.055	2.073	0.038
Well-being (WHO-5)	-0.086	-3.168	0.002
Age groups	0.077	3.906	<0.0001
Faith as a stronghold	0.073	2.768	0.006
Stressors (5NRS)	0.071	2.335	0.020
Dependent variable: Digital media usage Model 6: $F = 27.4$, $p < 0.0001$; $R^2 = 0.06$			
(Constant)		11.233	<0.0001
Mediation	0.140	6.340	<0.0001
Awe/Gratitude (GrAw-7)	0.092	3.913	<0.0001
Loneliness/Social Isolation (NRS4)	0.076	2.649	0.008
Cohort	-0.099	-4.664	<0.0001
Life satisfaction (BMLSS-10)	0.072	2.868	0.004
Stressors (5NRS)	0.074	2.344	0.019

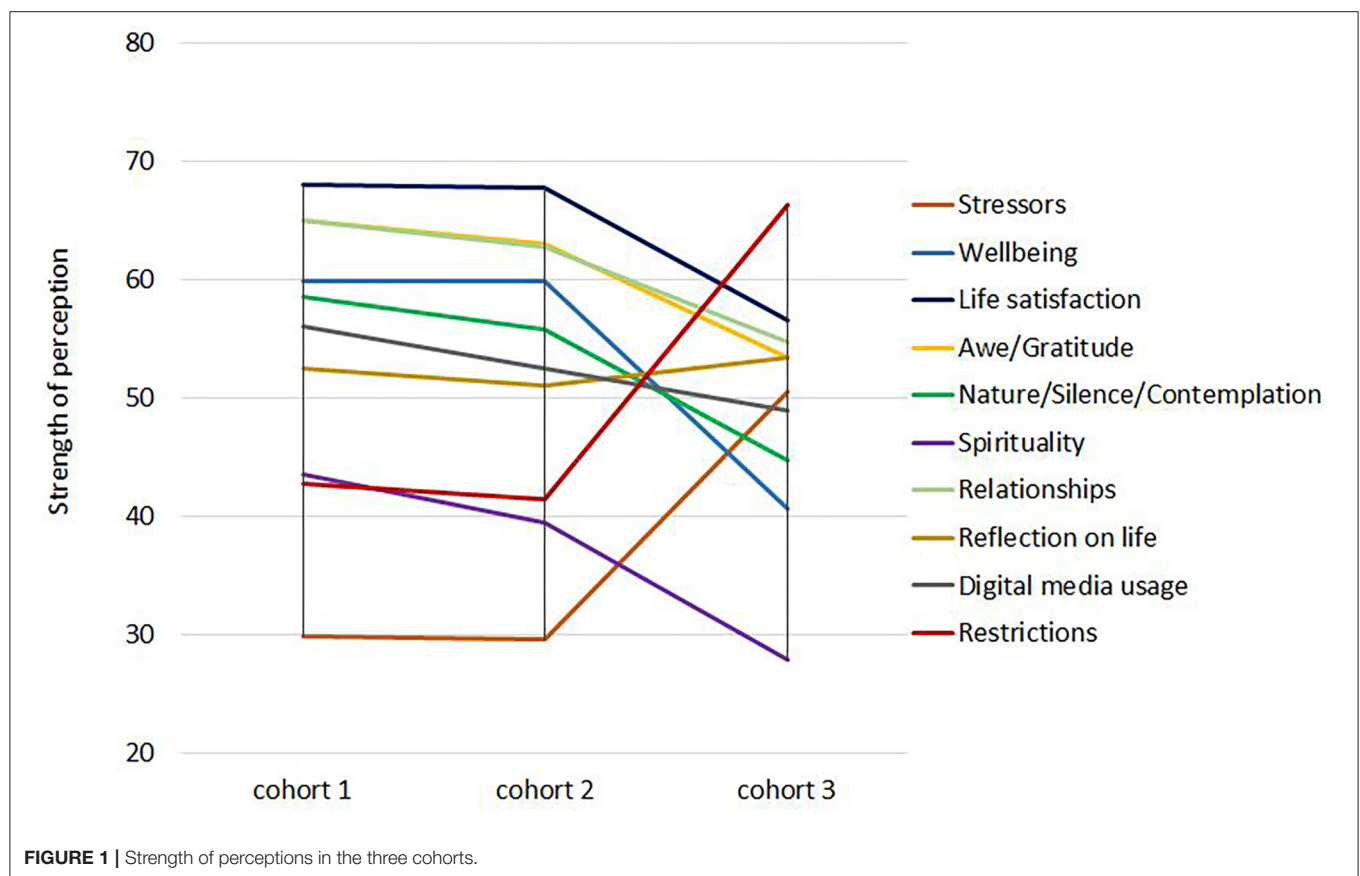
(Continued)

TABLE 7 | Continued

Dependent variable: Perceived Restrictions
 Model 7: $F = 383.5$, $p < 0.0001$; $R^2 = 0.53$

(Constant)		9.074	<0.0001
Stressors (5NRS)	0.321	13.581	<0.0001
Loneliness/Social Isolation (NRS4)	0.304	14.929	<0.0001
Well-being (WHO-5)	-0.100	-4.816	<0.0001
Cohort	0.079	5.227	<0.0001
Life satisfaction (BMLSS-10)	-0.083	-4.405	<0.0001
Meditation	-0.043	-2.961	0.003
Age group	0.034	2.312	0.021

Variables included in the stepwise regression analyses: age groups, Well-being (WHO-5), life satisfaction (BMLSS-10), Awe/Gratitude (GrAw-7), Stressors (5NRS), Loneliness/Social isolation (NRS4), Faith as a stronghold, meditation, praying, cohort.



within the group of religious persons, the frequency of meditation [Hedges' $g = 0.50$ (0.40–0.60)] and praying [Hedges' $g = 0.61$ (0.51–0.72)] was decreasing from cohorts 1 to 3, yet stronger in non-religious participants [Hedges' $g = 0.73$ (0.54–0.91) and $g = 0.43$ (0.25–0.61), respectively]. This indicates, first, that there is a common strong impact of the second wave of the pandemic (including the second lock down) on these behaviors, which affect both religious and non-religious persons. Also, religious persons may have lost some of their motivation or confidence to rely on

their spirituality as a resource and were less engaged to meditate or pray. In line with this, even within the religious participants, agreement that they rely on their faith as a strong hold decreased from 46 to 32% and from 26 to 11% in nominally non-religious persons. A second indication hints to the use of meditation which dropped strongly among non-religious participants between the first and third cohorts ($g = 0.73$), while prayer dropped less ($g = 0.43$); in comparison, the decrease of meditation among religious persons was moderate ($g = 0.50$), of prayer however

stronger ($g = 0.61$). This may indicate that in the first period, recommendations or stimuli for times to reflect (or even times for meditation) were received positively by non-religious persons; the longer the pandemic has taken, however, the stronger many of them may have got tired of it. The religious cohorts show a similar effect for praying which they may have intensified during the first lockdown which they neither kept up nor started again during the second lockdown. This is a global observation which would call for a more qualitative investigation of which personal meanings both groups across the cohorts tend to associate with meditation and praying personally. Further, the quite low satisfaction with the support of their local religious communities during the pandemic was significantly declining in the second wave of the pandemic, too. It seems that the expectations that the own faith (in terms of public and private religiosity) can be utilized as a resource to rely on, was shaken in several persons, also in religious people.

In the light of our findings, one has to state that the decline of positive perceptions, particularly for Nature/Silence/Contemplation, Spirituality, and Relationships, might be due to a lack of motivation and courage, too, or a downgrading (adaptation) of emotional engagement as a consequence of the generalized tiring burden of the pandemic measures. Participants' hope that the "easiness" of the summer months will continue was gone, and they were facing the reality of the second wave of the pandemic with all its social restrictions once again. Thus, perceived restrictions and stressors were increasing, and well-being and life satisfaction were declining. The respective dynamics are depicted in **Figure 1**.

Awe/Gratitude was confirmed as the best predictor of the perceived positive changes related to the perceptions, particularly Nature/Silence/Contemplation, while the cohort itself as an independent variable had only marginal influence on the respective scores. Nevertheless, this ability to stop in wondering awe and gratitude is decreasing during the second wave of the pandemic, too, and can be utilized as a buffering resource only in part.

It was striking that directly after the first lockdown idealistic thoughts were of relevance (these can be seen as an indicator of hope). On the one hand, people had fear for the future but nevertheless had hope that we ("afterwards") as global mankind will pay more attention to each other. However, during the course of the pandemic the fears were increasing and hope declining. Also, the idealistic motivation to start working to ensure that the world becomes fairer in the future decreased in cohort 3. These are further indicators that the pandemic has impact also on future perspectives, hopes, ideals, and meaning constructs. Persons perceiving in this way are not "sick" and would necessarily require psychological/medical help, but they are nevertheless heavily burdened and require support which is so far not provided. A clear perspective seems to be critical in order to be able to persevere. Rather, all idealistic goals at what time point the pandemic could be "mastered" were not reliable. Setbacks, new virus mutations, and the beginning of the 3rd wave with again increasing death rates give rise to little hope in the general population. Thus, there is a need for new and not yet defined public

health communities that could focus on persons which are affected in their physical, mental, social, and spiritual health and well-being due to the pandemic. The psychological and social outcomes of the pandemic experiences are so far not yet clear and require early planning processes. Two important topics to deal with in this context are risk perception and prevention. In a sample from China, Ding et al. (34) have shown that participants' risk perception was associated with depressive states in a differentiated way: *affective* risk perception was positively associated with depression, while *cognitive* risk perception was negatively associated. In addition, "support of prevention and control policies" was inversely related with depression. These findings would imply that health policies should provide reliable information about groups at risk and about general risk protection strategies to reduce fears and worries, and to maintain peoples' health and well-being. Further, government responses to cope with public crises are required to be meaningful and comprehensible in order to get public acceptance, thereby avoiding insecurity and anxiety. Further, a study at the start of the pandemic in Italy revealed that person-related psychological factors may play an important role for risk perceptions and psychological interventions, i.e., "empathy, self-efficacy, and imagination" (35). These resources could help to empower persons in difficult situations. In this study, it was the ability to mindfully stop in wondering awe with subsequent feelings of gratitude that predicted the positive perceptions—a resource that could be trained. However, in several situations peoples' affective reactions have a stronger impact on their behaviors than cognitive approaches, and dealing with this affective reality remains an important task for health care policies.

Limitations

This is not a longitudinal study with the same participants but with different cohorts at different time-points. Therefore, one has to consider differences in sociodemographic data. These were considered in this evaluation, particularly the higher proportion of non-religious persons in cohort 3. We can underline that being non-religious would account for 1% only of the variance of well-being, life satisfaction, awe/gratitude, Nature/Silence/Contemplation, and 1.5% of the stressor variance.

Further, the study was performed as an online survey with a snowball sampling method and we do not assume that the findings are representative for all groups in German societies as we may not have reached all social groups in a similar manner. To avoid a bias, we have excluded all religious persons living in monastic structures (brothers and sisters, monks, and nuns) which were participating predominantly directly after the first lockdown.

CONCLUSIONS

Findings indicate that several perceptions, attitudes, and behaviors have changed, particularly during the second wave of the pandemic, which had a strong influence on psychological health. Well-being and life satisfaction decreased along with perceived restrictions. The ability to perceive the Sacred in

life (in terms of mindful awareness) was confirmed as the best predictor of perceived positive changes, particularly on Nature/Silence/Contemplation. However, this resource may not buffer against the negative outcomes of the pandemic but helps to recognize the still positive aspects in life in terms of an awareness shift to protect own abilities to positively participate in life concerns. Whether this ability could be trained to better cope with the pandemic restrictions remains to be shown. At least it can be stated that spiritual/religious persons may have a benefit in the ability to be more aware for these perceptions than non-spiritual/non-religious persons. However, even this resource was declining in the second wave of the pandemic with its second lockdown. The lack of a positive perspective, that there will be an end of the pandemic, seems to be a highly burdening situation which is difficult to cope with.

DATA AVAILABILITY STATEMENT

According to the data protection regulations, the data set cannot be made publicly available. Data are however available from the first author upon reasonable request.

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ETHICS STATEMENT

Ethical review and approval was not required for this anonymous study on healthy human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements. By filling in the anonymous online questionnaire, interested persons consented to participate.

AUTHOR CONTRIBUTIONS

AB designed the study and set up the online survey. TD, JS, and AB initiated the sampling processes. AB and DR undertook statistical analyses. AB, DR, and KB wrote the first draft of the paper. All authors provided feedback 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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Association Between Physical Exercise and Mental Health During the COVID-19 Outbreak in China: A Nationwide Cross-Sectional Study

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The COVID-19 has undergone several mutations, and caused deleterious effects on physical and mental health of people worldwide. Whilst physical exercise is known for its positive effect on enhancing immunity and reducing the negative consequences of unhealthy emotional states caused by the pandemic; there is a severe lack of psychological exercise intervention measures and mitigation strategies to advance the knowledge and role of physical exercise to improve mental health in most countries. This study surveyed the association between physical exercise and mental health burden during the COVID-19 outbreak in China to better understand the influence of different physical exercise types on reducing mental health burden during the pandemic. ANOVA, binary logistic regression, the chi-square test, and Spearman's correlation analysis were used for statistical analysis. 14,715 participants were included. The results showed that Chinese residents had several poor mental health conditions during the COVID-19 outbreak. And there was a significant positive correlation between the extent of adverse effects on mental health and provincial proportions of confirmed COVID-19 cases ($r = 0.365$, $p < 0.05$). Some main factors caused an unhealthy psychological status, including epidemic severity (62.77%, 95% CI 58.62-65.64%), prolonged home quarantine (60.84%, 95% CI 58.15-63.25%), spread of large amounts of negative information about COVID-19 in the media (50.78%, 95% CI 47.46-53.15%), limitations in daily life and social interaction (45.93%, 95% CI 42.46-47.55%), concerns about students' learning (43.13%, 95% CI 40.26-45.48%), and worries about being infected (41.13%, 95% CI 39.16-45.23%). There was a significant association between physical exercise and mental health. The largest associations were seen for home-based group entertainment exercise (i.e., family games, rope skipping, and badminton), Chinese traditional sports (i.e., Chinese martial arts, Taijiquan and Qigong), and popular sports (i.e., yoga, video dancing, sensory-motor games, and whole-body vibration), as well as durations of 30-60 min per session, frequencies of three to five times per week and a total of 120-270 min of moderate-intensity exercise weekly during the COVID-19 outbreak ($p < 0.05$).

Keywords: COVID-19, Chinese residents, physical exercise, mental health, home quarantine

INTRODUCTION

The novel coronavirus disease (COVID-19) has led to over 180 million confirmed cases and over 4 million deaths globally as of 12th July 2021, including 92,066 confirmed cases and 4,636 deaths in China (1). Governmental in various countries have implemented urgent national containment strategies to prevent the spread of the pandemic and reduce the risk of national medical systems becoming critically overburdened (2–4). Although social distancing and home quarantine measures aimed to reduce human-to-human transmission of the COVID-19, such measures have caused dramatic changes in people's routine daily activities and lifestyles, e.g., decreased physical activity and increased sedentary time (5). The great life-altering may not only adversely affect the immune function leading to several chronic diseases (6), but also increase the risk of mental health problems (e.g., depression, anxiety, and loneliness) (7, 8) and even psychological imbalance and instability (9). For example, recent studies have shown that 54% of the general population had mental health burden and 29% had anxiety symptoms during the COVID-19 outbreak in China (10), almost 30% of adults had depression, anxiety, and stress after the onset of COVID-19 in Australia (11).

An overwhelming body of evidence has demonstrated the positive benefits of engaging in adequate physical exercise on improving mental health well-being (12–14). For example, previous review and meta-analysis have shown that appropriate exercising at social isolation may enhance self-efficacy and self-mastery to control and reduce depression (15) and anxiety (16), and may increase self-acceptance to achieving internal goals and satisfactions (17); recreational and home-based group exercise may provide an environment for emotional communication and sharing to relax and relieve mental and emotional stress (18). However, relevant evidence has indicated a high prevalence of physical inactivity among the general population (19), which has worsened due to the outbreak of the pandemic (5). And there is a severe lack of psychological exercise intervention measures (20), and individuals in social isolation have very limited or no access to mental healthcare during the pandemic in most countries (21). To design effective physical exercise promotion programs to help people reap the great benefits of regular physical exercise on mental health well-being during the pandemic, a better understanding of the interrelationship between physical exercise and mental health in the special context is vitally important, especially in a national representative sample. Given that the improvement of mental health may vary as a function of different physical exercise forms, frequencies, intensities, or duration (22, 23), we intended to explore answers for the following questions: what types of physical exercise are beneficial for improving psychological status? Whether all types are equally beneficial for improving mental health, or whether certain forms of physical exercise have advantages over others during the epidemic?

From January 24 to April 22, the Chinese government adopted a series of prevention strategies, such as locking down entire cities and implementing home quarantines and social distancing, and consequently, the epidemic was effectively controlled within 3 months (17, 24). This situation in China may offer a

relatively stable research environment and a huge amount of samples to this study due to the essential research question is the relationship between physical exercise and mental health during the epidemic. Therefore, the study aimed to reveal the association between physical exercise and mental health during the outbreak of COVID-19 in China through a large-sample survey. Investigations such as the present study are essential for providing evidence to inform policymakers and guide future policy and program planning to promote physical exercise and improve mental health during periods of public health emergencies.

MATERIALS AND METHODS

Study Population

According to the Chinese Health Commission, which defined the stages of development of the epidemic in China, the peak of the COVID-19 outbreak in China was from January 24 to April 22, 2020. The study recruited Chinese residents living in 31 provinces of China covered by the physical fitness monitoring point system during this period. The study sample included individuals who were not infected with COVID-19 because China has adopted unified quarantine management measures for people infected with COVID-19. The participants were divided into the following 10 groups based on their age: 17 years old and below, 18–24 years old, 25–29 years old, 30–34 years old, 35–39 years old, 40–44 years old, 45–49 years old, 50–54 years old, 55–59 years old, 60 years old and above. The sample size of each province with quotas based on the sampling plan of the sixth national physical fitness monitoring. Furthermore, full ethical approval was obtained from the Wuhan Sports University, and all participants gave informed consent.

Survey Methodology

This was a nationwide cross-sectional study. The survey content included physical exercise and mental health data, and the participants' gender, age, education level, geographic location (province and city), and social factors, such as occupation and region (towns and villages). The study used a snowball sampling strategy to recruit questionnaire respondents due to the recruitment pool of participants, and a questionnaire was distributed *via* the WeChat and social media platforms with high click-through rate and usage rate of all group. In addition, instructors in social sports in various communities, cities, and provinces participated in questionnaire distribution *via* their working platforms. Through these ways, ensure that residents from different regions of the country participated and to maximize the diversity and representativeness of the population participating in the survey. Within the questionnaire, participants were asked to recall their mental health and physical exercise during the pandemic. The data collection period was from June 20 to July 30, 2020.

Physical exercise data were collected using the Chinese version of the International Physical Activity Questionnaire (IPAQ-C) (21). All data were managed and screened according to standard methods and the guidelines for data processing and analyses of the IPAQ. Individuals were asked to recall the type, intensity,

TABLE 1 | Basic characteristics of the respondents ($n = 14,715$ participants).

Category	Frequency	Percent	Mean	Standard deviation
Gender				
Male	6,894	47%	1.53	0.50
Female	7,821	53%		
Age (years)				
≤17	1,258	8.5%	4.93	2.31
18 ~ 24	2,480	16.9%		
25 ~ 29	2,054	14.0%		
30 ~ 34	1,615	11.0%		
35 ~ 39	1,756	11.9%		
40 ~ 44	1,704	11.6%		
45 ~ 49	920	6.3%		
50 ~ 54	1,040	7.1%		
55 ~ 59	828	5.6%		
60 ~ 69	1,060	7.2%		
Education level				
Primary school and below (including those with no systematic education)	753	5%	5.25	1.34
Junior high school	1,630	11%		
High school (higher vocational school, technical secondary school, and technical school)	1,873	13%		
Junior college (self-examination, adult education, and promotion)	3,176	22%		
Bachelor's degree	4,909	33%		
Master's degree or above	2,374	16%		
Urban and rural areas			1.34	0.48
Cities and towns	8,039	55%		
Rural	6,676	45%		
Profession				
Front-line medical staff for epidemic prevention	520	4%	7.94	3.40
Front-line epidemic prevention volunteer	599	4%		
Public institution/civil servant/government staff	1,559	11%		
Professional (e.g., teacher/lawyer)	1,538	11%		
Service personnel (e.g., catering waiter/driver/salesperson)	742	5%		
Freelancer (writer/artist/tour guide, etc.)	694	5%		
Worker (e.g., factory worker/construction worker/city sanitation workers)	674	5%		
Company employee	1,516	11%		
Businessman/employer/salesperson/self-employed	620	4%		
Student	3,005	21%		
Housewife	801	6%		
Farmer/herdsman/fisherman	1,154	8%		
Unemployed/unemployed	997	7%		

frequency, and duration of various physical exercises they engaged in per day and per week during the COVID-19 outbreak.

Mental health was assessed using the 50-item Self-evaluation Table for Chinese Residents' Mental Health during the Outbreak Peak of COVID-19, which was compiled based on the Symptom Checklist 90 (SCL-90). The Cronbach's alpha coefficient was 0.91, and the test-retest reliability was above 0.7. The internal consistency was 0.87. Individuals were asked to recall the specific influences on their mental health during the pandemic, as well as the specific changes in anxiety, fear, depression, somatization, and stress before and after physical activity. Each item was rated on a five-point Likert scale, ranging from 1 (very slightly or not at

all) to 5 (extremely), to assess the extent to which the participants felt that each mental health item pertained to them during the peak of the COVID-19 outbreak. The higher the total score indicated more serious the individual's psychological problems and the lower his or her mental health level.

Statistical Analysis

All data were analyzed with SPSS software 26.0 (IBM Inst., Chicago, IL, USA). Descriptive statistics such as percentages, 95% CIs, means, and standard deviations were calculated for categorical variables and continuous variables to reflect the demographic characteristics of the survey population. The

TABLE 2 | Distribution of respondents across provinces and cities.

Province	Count	Province	Count	Province	Count
Beijing	408	Anhui	518	Guizhou	385
Tianjin	450	Fujian	657	Yunnan	455
Hebei	393	Jiangxi	687	Tibet	301
Shanxi	433	Henan	739	Chongqing	285
Inner Mongolia	336	Hubei	824	Shanxi	359
Liaoning	455	Hunan	780	Gansu	351
Jilin	453	Guangdong	742	Qinghai	389
Heilongjiang	302	Guangxi	483	Ningxia	437
Jiangsu	583	Hainan	489	Xinjiang	240
Zhejiang	406	Sichuan	507		
Shanghai	386	Shandong	482		

Kolmogorov-Smirnov test was used to test the normality of continuous variables. Spearman's correlation coefficients were calculated to assess the relationship between the provincial proportions of confirmed COVID-19 cases and the extent of adverse effects on mental health in various provinces and cities. The chi-square test was used to determine the statistical significance of the differences in the proportions of confirmed COVID-19 cases among provinces and the mental health status of participants from different provinces. Regression analysis was conducted to reveal the effect of self-reported physical exercise (i.e., type, duration, and frequency) on reducing mental health burden during the COVID-19 outbreak. Weekly total duration of physical exercise was calculated.

The provincial proportions of confirmed COVID-19 cases were calculated by dividing the total number of confirmed COVID-19 cases (as of 22 April 2020) by the total population (as of the end of 2019) for each of the 31 provinces. The provincial population at the end of 2019 was quoted from the China Statistical Yearbook published by the National Bureau of Statistics of China (2020).

RESULTS

Survey Respondents

During the COVID-19 pandemic, a total of 14,715 participants were included in the final analysis (Table 1); these participants were from 31 provincial administrative regions in mainland China (Table 2).

Mental Health Status

During the COVID-19 outbreak, mental health was affected to varying degrees across all groups (Table 3), with somatization (2.416, 95% CI 2.401-2.431), anxiety (2.315, 95% CI 2.300-2.330) and stress (2.218, 95% CI 2.203-2.232) being affected to a greater extent than other aspects of mental health.

Factors Affecting Psychological Status

We observed many factors that could cause mental health burden (Figure 1) during the COVID-19 outbreak, with the main factors including epidemic severity (64.77%, 95% CI

TABLE 3 | Mental health status during the COVID-19 outbreak.

	M ± SD	Variance	95% CI (LL)	95% CI (UL)
Somatization	2.416 ± 0.925	0.855	2.401	2.431
Anxiety	2.315 ± 0.922	0.851	2.300	2.330
Depression	1.879 ± 0.876	0.767	1.865	1.893
Stress	2.218 ± 0.896	0.803	2.203	2.232
Fear	1.818 ± 0.840	0.705	1.805	1.832

M, mean; SD, standard deviation.

58.62-67.64%), prolonged home quarantine (62.84%, 95% CI 57.15-64.25%), spread of large amount of negative information about COVID-19 in the media (54.78%, 95% CI 49.46-58.15%), limitations in daily life and social interaction (46.93%, 95% CI 43.46-48.55%), concerns about students' learning (43.13%, 95% CI 40.26-45.48%), and worries about being infected (42.13%, 95% CI 39.16-45.23%).

Correlation Analysis of Mental Health Status and Infection Rate in Provinces and Cities

Correlation analysis was carried out on the degree of influence on mental health and the COVID-19 infection rate (per million people), and the Pearson correlation coefficient was used to indicate the degree of the correlation. According to the scatter plot to determine the linear fit of the data, the degree of influence on mental health = 0.0114* infection rate (per million) + 3.5175, and the R-squared value was 0.133. The analysis showed that the correlation value between the degree of the effect on mental health and the provincial proportions of confirmed COVID-19 cases (per million people) (Figure 2) was 0.365 ($p < 0.05$) (Figure 3), indicating a significantly positive correlation between these two variables.

Analysis of the Influence of Physical Exercise on Mental Health

The Positive Influence of Physical Exercise on Mental Health Status

During the outbreak of COVID-19, physical exercise had significant positive effects on reducing mental health burdens, including somatization, anxiety, depression, stress and fear, for all age groups (2.79, 95% CI 3.34-2.13, Table 4); for each type of mental health burden, the correlation with physical exercise was > 0 .

Influence of Physical Exercise Types on Mental Health

Binary logistic regression was used to analyze the influence of physical exercise types on mental health improvement during the COVID-19 outbreak period. A P -value < 0.05 indicated that the physical exercise type influenced mental health improvement. The box chart was drawn to show the improvement in mental health with each exercise type and the 95% CI values as the error lines. We observed that specific types of physical exercise

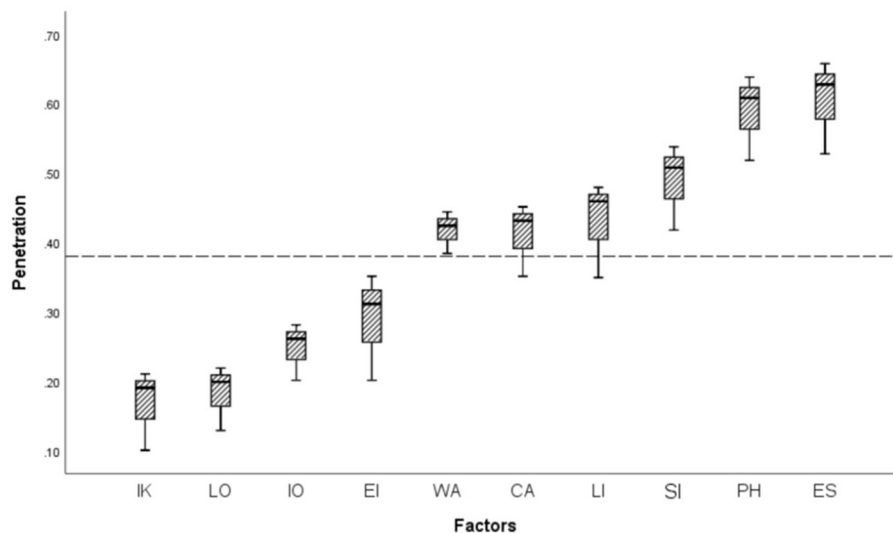


FIGURE 1 | Factors affecting mental health during the COVID-19 outbreak. IK, Insufficient knowledge and understanding of epidemic prevention measures; LO, Lack of effective epidemic prevention equipment; IO, Impact on work processes; EI, Impact on economic income; WA, Worries about being infected; CA, Concerns about students' learning; LI, Limitations in daily life and social interaction; SI, Spread of large amounts of negative information about the epidemic; PH, Prolonged home quarantine; ES, Epidemic severity.

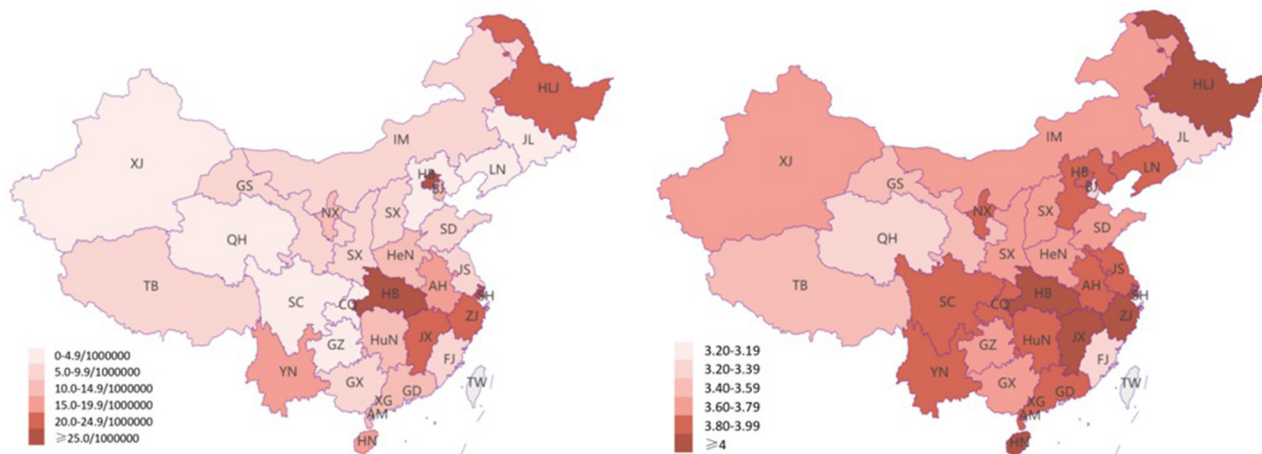


FIGURE 2 | The COVID-19 infection rate and psychological impact in each province and city. The first map shows the provincial proportions of confirmed COVID-19 cases, and the second map shows the psychological impact.

were associated with a greater reduction in mental health burden than others during the pandemic (Figure 4), including home-based group entertainment exercise, such as family games (3.151, 95% CI 2.915-3.342), rope skipping and badminton (3.087, 95% CI 2.869-3.192); Chinese traditional sports (2.806, 95% CI 2.694-3.010), such as Chinese martial arts, Taijiquan and Qigong; and popular sports, such as yoga (2.587, 95% CI 2.474-2.742), video dancing (2.431, 95% CI 2.324-2.572), sensory-motor games and whole-body vibration (2.402, 95% CI 2.311-2.502).

Influence of Physical Exercise Intensity on Mental Health

According to the standards of the International Health Organization (23), physical exercise intensity is divided into vigorous intensity ($\geq 80\%$ of the maximum heart rate, manifested as strenuous activity, shortness of breath, and accelerated heart rate, which can cause significant fatigue), moderate intensity (~ 60 - 69% of the maximum heart rate, manifested as slightly increased breathing and heart rate during exercise, no shortness of breath, slight sweating, slight fatigue, and waking up the next

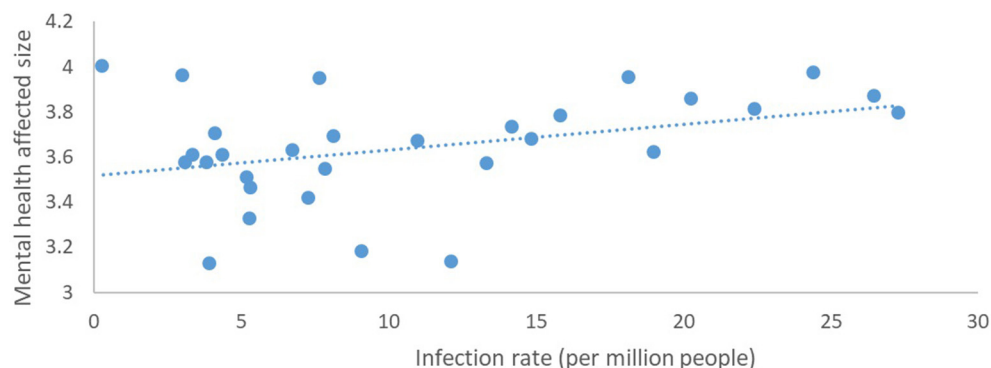


FIGURE 3 | The relationship between the degree of mental health impact and provincial proportions of confirmed COVID-19 cases.

TABLE 4 | The positive influence of physical exercise on mental status.

	M ± SD	Variance	95% CI (LL)	95% CI (UL)
Improved somatization	2.09 ± 1.109	1.231	2.54	1.73
Decreased anxiety	3.02 ± 1.112	1.236	3.95	2.06
Decreased depression	2.32 ± 1.117	1.248	2.58	1.69
Decreased stress	2.81 ± 1.113	1.239	3.55	2.6
Decreased fear	3.25 ± 1.103	1.217	3.59	3.03
Improved mental health	2.79 ± 1.049	1.099	3.34	2.13

M, mean; SD, standard deviation; CV, coefficient of variation.

day without feeling tired), and light intensity (~35–59% of the maximum heart rate, such as when walking slowly, and feels relaxed). We found that moderate-intensity exercise (3.242, 95% CI 3.01–3.58, $p < 0.05$) was better than both light-intensity (2.56, 95% CI 2.31–2.78, $p < 0.05$) and vigorous-intensity (3.03, 95% CI 2.19–3.14, $p < 0.05$) exercise for mental health improvement during the COVID-19 outbreak in China (Figure 5).

We observed inverted U-shaped associations between mental health improvement and exercise duration per session (Figure 6) as well as frequency of exercise per week (Figure 7). According to the duration per session of different exercise intensities, the average degree of mental health improvement was fitted, and a trend chart was drawn for all levels of physical exercise intensity. An exercise duration per session between 30 and 60 min ($p < 0.05$) was associated with the best mental health improvement. In general, lower reductions in mental health burden were seen for individuals who engaged in more than 90 min of exercise during the pandemic.

Regarding exercise frequency, three to five times per week was associated with the best mental health improvement (Figure 7, $p < 0.05$). In general, small reductions in mental health burden were seen for individuals who participated in physical exercise fewer than three times per week or more than six times per week.

For all types of mental health burden, a total time of physical exercise per week between 120 and 270 min was associated with the best mental health improvement during the COVID-19 outbreak in China (Figure 8, $p < 0.05$).

DISCUSSION

Analysis of Mental Health Status

The present study showed that during the COVID-19 outbreak, people in China experienced adverse psychological symptoms, such as anxiety, depression, stress, fear, and somatization. Moreover, we found a positive and significant correlation between provincial proportions of confirmed COVID-19 cases (per million people) and the degree of effects on mental health, and epidemic severity was the most important factor causing mental health burden. Fei Qin et al. (5) also reported a similar correlation ($r = 0.501$, $p = 0.004$) at the beginning of the outbreak in China.

Overall, the growing numbers of confirmed COVID-19 cases, deaths and the uncertainty of infection could raise stress and anxiety, while depressive and loneliness were likely due to the mandatory social distancing measures during the COVID-19 outbreak (25); all these factors could cause deleterious effects on mental, cardiovascular and immune health (26). Home quarantine also poses considerable financial, psychological and emotional problems for people and might lead to an increase in mood disorders such as panic disorder, anxiety and depression (27). In addition, the COVID-19 outbreak was the first social-media information epidemic (28). With screen time exceeding 4 h per day during the home quarantine of Chinese citizens at the beginning of the COVID-19 outbreak (5), the large amounts of information disseminated by the media was likely to increase public concern about being infected and to induce or exacerbate public anxiety, stress, and other adverse emotions. For example, a survey showed that 54% of respondents rated the mental health impact of the COVID-19 outbreak as moderate or severe, 29% reported moderate to severe anxiety symptoms during the COVID-19 outbreak in China (10). Somatization, anxiety, fear, and stress were higher than normal in front-line medical staff working in epidemic prevention. However, most people did not receive effective physical exercise interventions for mental healthcare during the pandemic (20).

Similar problems occurred worldwide. For example, almost 30% of adults drank more than usual to cope with their psychological depression, anxiety, and stress after the onset

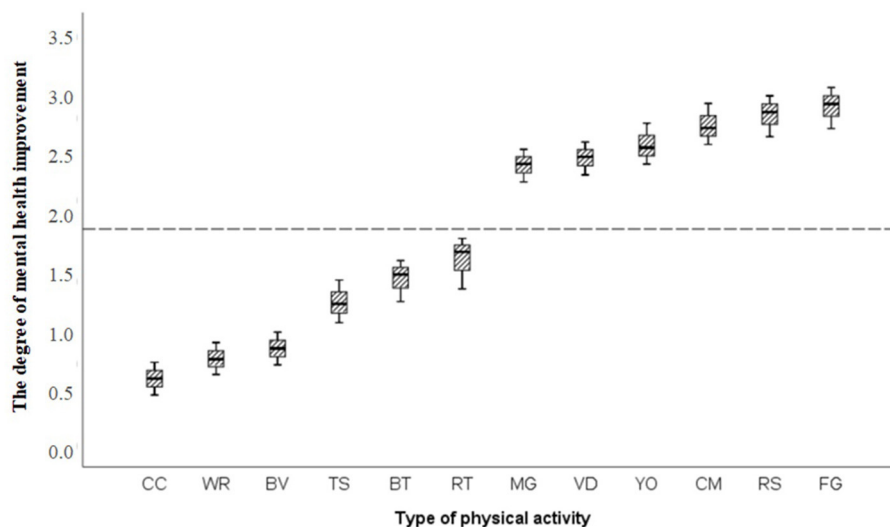


FIGURE 4 | The effect of physical exercise on improving mental health. CC, Chess classes; WR, Walking or running; BV, Basketball, volleyball or football; TS, Taking the stairs; BT, Badminton, tennis or table tennis; RT, Resistance training. MG, Sensory-motor games and whole body vibration; VD, Video dancing; YO, Yoga; CM, Chinese martial arts, Taijiquan and Qigong; RS, Rope skipping or badminton; FG, Family games.

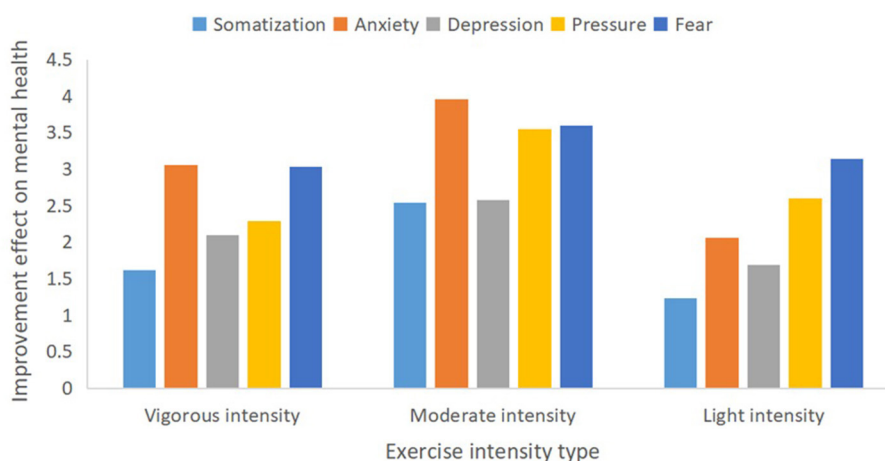


FIGURE 5 | Different physical exercise intensities and mental health improvement.

of COVID-19 in Australia (11). In Italy, prolonged home quarantine was found to be associated with increased mental health burden, including post-traumatic stress symptoms, avoidance behaviors, and anger (29). In addition, poor mental health states are known to increase the risk of acute respiratory infections (8) and to produce deleterious effects on cardiovascular and immune health (9). Therefore, promoting mental health is important and necessary during the pandemic.

In addition, the United Nations Educational, Scientific and Cultural Organization reported that ~861.7 million students were out of school worldwide due to COVID-19 (13). As the result of the pandemic, the Chinese government implemented a comprehensive school closure strategy. In the first half of 2020, some secondary school students were facing secondary and

high school exams and college graduates needed to find jobs in China. The limitations on students' learning increased anxiety and stress among parents and students. However, the timely and comprehensive online learning strategy adopted by the Chinese government somewhat alleviated the stress and anxiety caused by the suspension of offline classes (6). But excessive screen time also generates certain adverse effects. For example, a survey of the National Ministry of Education showed that the myopia rate of primary and secondary students increased by 11.7% during the epidemic prevention period in China (the first half of 2020) (30).

Almost all people are vulnerable to mental health problems in the face of public health emergencies. During the SARS pneumonia (31) and influenza A H1N1 (32) outbreaks, people also experienced a variety of psychological problems in China,

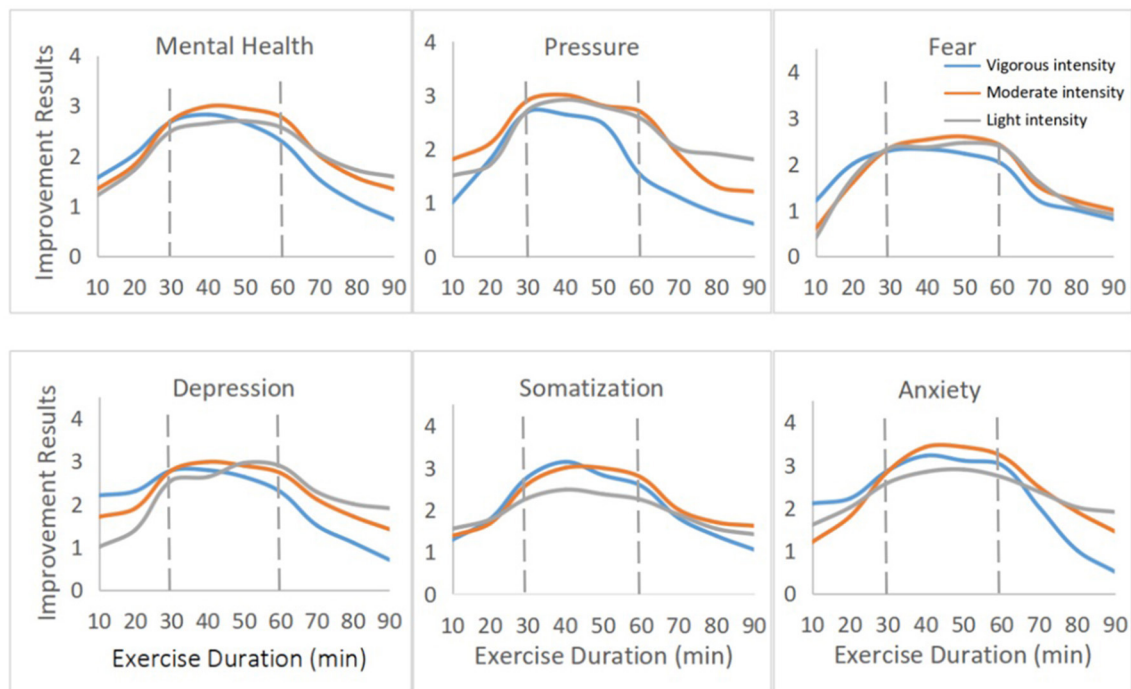


FIGURE 6 | The association between mental health improvement and exercise frequency per week.

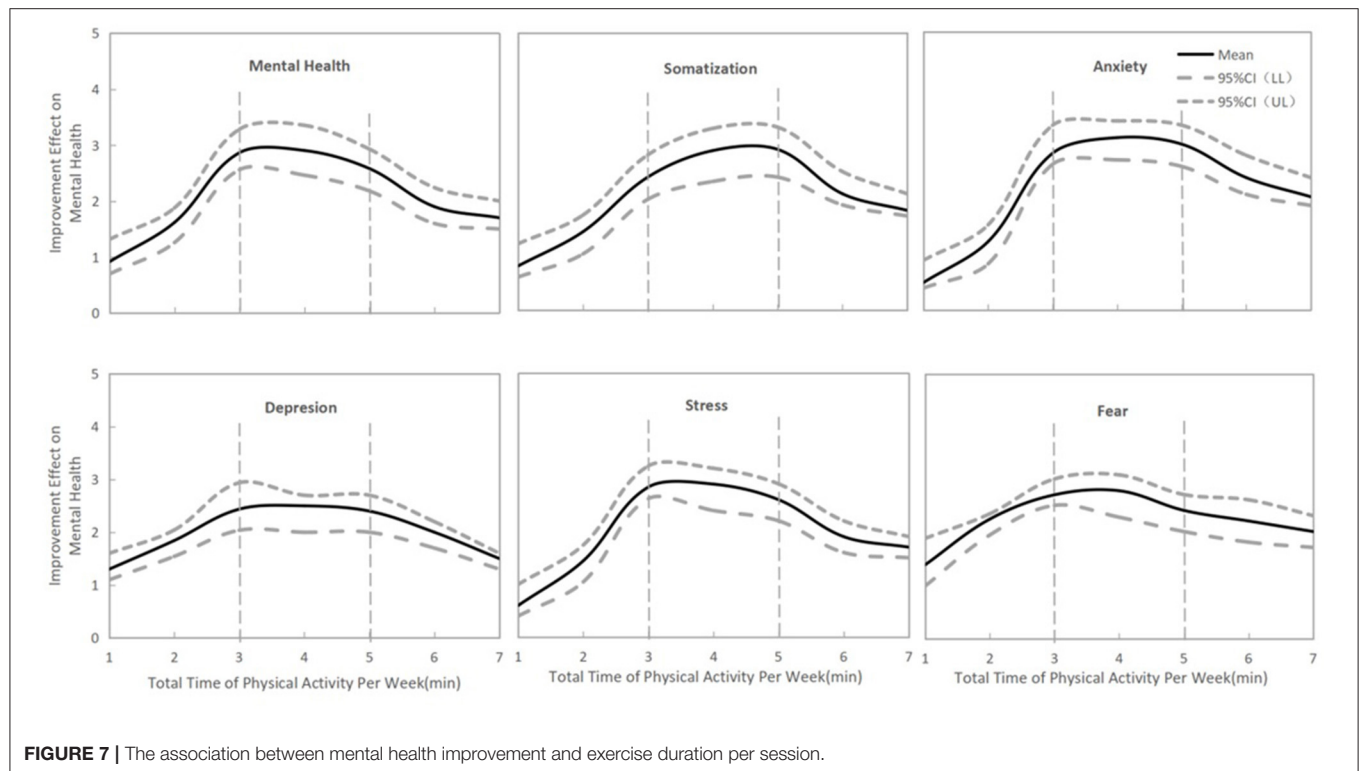


FIGURE 7 | The association between mental health improvement and exercise duration per session.

such as anxiety, depression, and panic. During the outbreak of COVID-19, the Chinese government established a strong

material security system to ensure that people had sufficient epidemic prevention equipment, medical testing and treatment

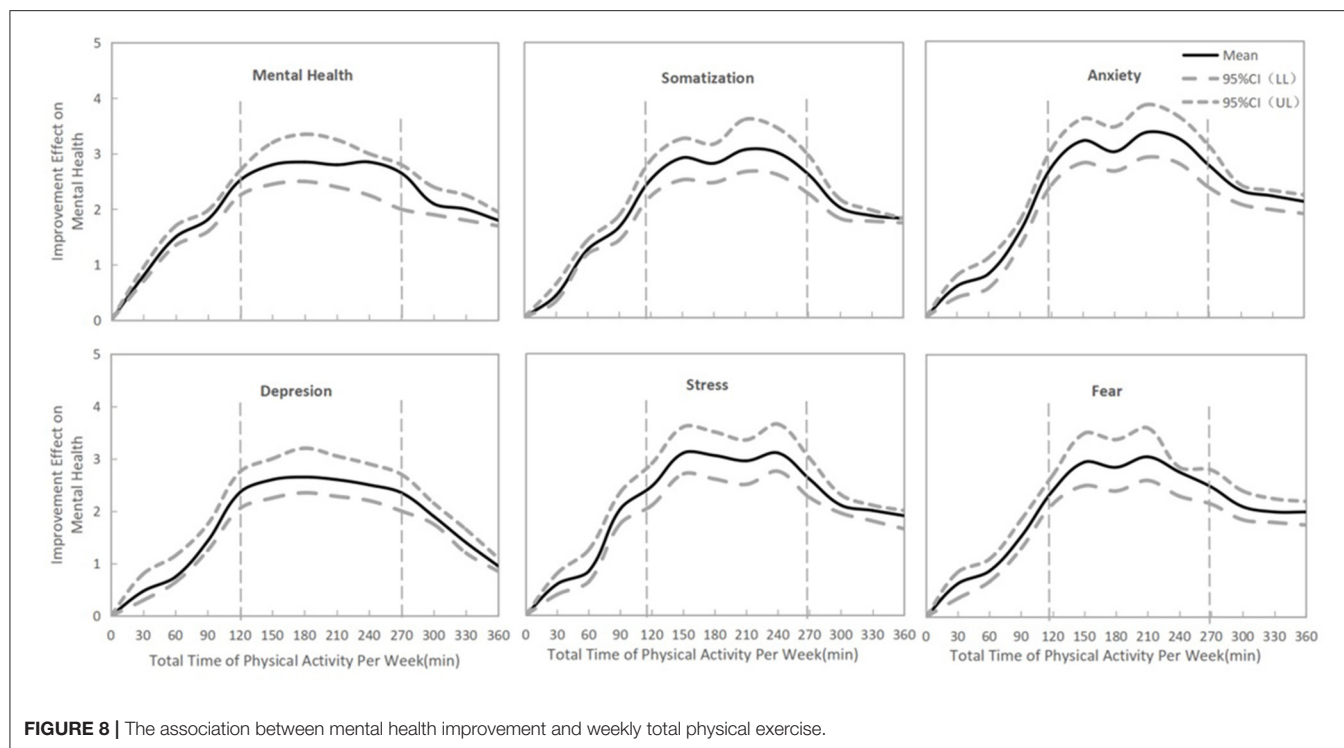


FIGURE 8 | The association between mental health improvement and weekly total physical exercise.

resources, which played an important role in reducing the mental health burden. However, areas that need to be improved to promote psychological health during the outbreak of COVID-19 include determining how to quickly build an authoritative information and media platform to strengthen the effective, accurate and authentic dissemination of various epidemic information and epidemic prevention knowledge, as well as determining how to improve people's home lives during the longer home quarantine period.

Analysis of the Relationship Between Physical Exercise and Mental Health

The present study showed that all types of physical exercise were associated with significant reductions in different types of mental health issues, such as stress, anxiety, depression, and somatization. Related studies have also reported positive effects of physical exercise in improving negative and unhealthy emotions (5, 33) in different populations during the COVID-19 pandemic. First, self-mastery is a crucial criterion for promoting positive impacts on psychological outcomes (34). Self-efficacy or mastery and psychological control were found to be enhanced when people maintained self-regulation, self-judgment, and self-discipline in engaging in physical exercise during the COVID-19 outbreak period. Exercising at home can increase individuals' sense of control and distract them from negative and worrying thoughts and rumination (9). Second, in the context of social isolation, physical exercise may be one key to increasing self-acceptance and one's sense of competence and to achieving internal goals and satisfaction, contributing to greater positive mental health (35). Third, physical exercise was found to

be an effective means of maintaining physical, mental and immune health and reducing socioeconomic burden or medical burden during the epidemic (5). However, few public health guidelines around the world include daily physical exercise routines for people living in varying degrees of quarantine during the pandemic (17). Individuals who were socially isolated during the epidemic were found to have no access to mental healthcare in the vast majority of cases (9). Overall, on the one hand, the government's efforts to improve physical exercise intervention for mental health during the epidemic should be strengthened. On the other hand, individuals' motivation to exercise should be stimulated to increase their desire to exercise and the awareness of the benefits of exercise for physical and mental health improvement among the general public. Finally, potential mechanisms for exercise intervention, monitoring and prevention mechanisms for improving mental health should be systematically developed during public health emergencies. Such measures are of great importance for strengthening the effect of physical exercise on mental health improvement.

Most people experienced restrictions on physical exercise and were forced to change their exercise methods during the COVID-19 outbreak (16). The study also observed that specific types, durations, and frequencies of physical exercise might be more effective than others for mental health improvement during the pandemic period.

Firstly, recreational and home-based group exercise can provide individuals with an environment for emotional communication, sharing and support from multiple individuals, which is of great benefit to mental and emotional relaxation and stress relief (18). Therefore, group-exercise formats that

involve activities with family members or the use of various forms of network visualization with friends or organizations may be more effective than individual exercise in reducing mental health burden.

Secondly, traditional Chinese sports and trendy forms of exercise may be associated with a better reduction in mental health burden. Related studies have reported that traditional Chinese sports, such as Chinese martial arts, Taijiquan and Qigong, which involve a sequence of movements and postures with the regulation of the breath rhythm and pattern, musculoskeletal stretching and relaxation, may be potentially useful for the prevention, treatment and rehabilitation of COVID-19, as well as for emotion control, stress reduction, mental improvement, and enhanced immune function (36–38). Related studies have also shown that popular sports have the potential to play a role in mental health improvement. For example, ~20 min of the moderate-intensity exergame Zumba Fitness significantly reduced anxiety in healthy young women (16). An 8-week video game intervention (i.e., dance, postural control, coordination, and walking training) was found to have a significant improvement in anxiety (39). In addition, sensory-motor activities were noted as safe, fun and valuable means of increasing girls' motivation to participate in physical exercise while staying at home (9). In general, the effectiveness of physical exercise in improving mental health depends on the degree of internalization of the behavior. Exercising at home may be accompanied by higher self-esteem and lower psychological ill-being when people are free to choose the exercise type, schedule, frequency and intensity that are consistent and assimilated with the individual's goals and interests, personal characteristics, abilities and identity (13). Therefore, according to public needs, the establishment of a library of traditional Chinese sports and trendy home-based exercises would be an effective measure to improve mental health during home quarantine and social distancing due to COVID-19.

Thirdly, related studies have reported that both the intensity of exercise (relative load lifted) and physiological adaptation (muscle strength gained) were significantly related to the magnitude of the depression response (40), and moderate-intensity exercising may be accompanied by health benefits including effective disease prevention and the maintenance of psychological, muscular, metabolic, and cardiovascular health during home isolation (41). On the one hand, based mainly on the J-shaped relationship between physical exercise intensity and muscle immunity (42), medium-intensity exercise may generate more health benefits for the immune system and the body's antiviral defenses (2). However, prolonged, acute and vigorous intensity may suppress immune system function, leading to upper respiratory tract infections and the appearance of latent viral reactivation (43, 44). On the other hand, based mainly on the U-shaped relationships between physical exercise intensity and mental health burden, moderate-intensity exercising may be associated with better mental health improvement than strenuous exercise (25).

Finally, we observed that moderate-intensity exercise lasting 30–60 min per session, a total of 120–270 min of exercise per week and exercise three to five times per week may have better

effects on mental health during the COVID-19 outbreak period in China. The International Health Organization recommended that healthy members of the population engage in a cumulative total of 150 min of moderate-intensity aerobic exercise (no <30 min in a single session) or 75 min of high-intensity exercise per week (22). A study also showed that moderate-intensity exercise 30–60 min duration (peaking at ~45 min) per session performed 3–5 times per week was associated with better psychological improvement than other forms of exercise. A worse mental health burden was seen for individuals who exercised more than 23 times per month, more than 6 h per week or more than 2 h per session (22). During the COVID-19 outbreak, home quarantine and social distancing led to severe restrictions on exercise types and facilities and a general lack of comprehensive exercise monitoring, guidance and atmosphere (6). Our investigation showed that more than 90 min of exercise per session and more than 300 min of exercise per week were associated with a significantly lower effect on psychological improvement. Therefore, significantly controlling the duration and frequency of physical exercise may be meaningful and useful for reducing the mental health burden during home quarantine.

Implications and Limitations of the Study

Our study has several limitations. Firstly, due to the large population of China, the population of different provinces and cities also varies. The questionnaires were distributed through community social platforms, WeChat and other Internet platforms in each province and city to ensure that residents from different regions of the country participated and to maximize the diversity and representativeness of the population participating in the survey. However, because it was an online survey, there was certain unevenness in the participants' age and regional distribution, with relatively more student participants (18–25 years old) and fewer older adults over 60 years old as well as more participants from Hubei and Hunan and fewer participants from Xinjiang and Heilongjiang. Secondly, although we chose the WHO-approved IPAQ-S and the SCL-90, which have high reliability and validity, the use of the participants' self-reported recall of physical exercise and mental health status during the pandemic might not have been as accurate as an intensity detection instrument test. Thirdly, it is necessary to conduct a comparative analysis of mental health status between those who participated in physical exercise and those who did not participate during the pandemic and to further reveal the in-depth effects of physical exercise on mental health, as well as the changing trends in psychological conditions with the continuous development of the epidemic and the extension of home quarantine. Finally, an important next step in our research is to further identify the comprehensive effect of exercise and the exercise intervention mechanism to promote psychological health and prevent COVID-19 infection. Despite these limitations, this study investigated the association between physical exercise and mental health in 31 provinces of China during the COVID-19 pandemic phase, and the results could guide future policies and planning to enhance physical exercise and promote mental health during public health emergencies.

CONCLUSION

During the COVID-19 outbreak, Chinese residents showed severe psychological burden, including anxiety, depression, stress, fear, somatization and other mental health burdens. The degree of mental health burden was significantly and positively correlated with the provincial proportions of confirmed COVID-19 cases. The identified factors which severely affected mental health are (1) the severity of epidemic at the national and local levels, (2) the long-term home quarantine, (4) the spread of a large amount of negative information about COVID-19 in the media, (4) limitations in daily life and social interaction, (5) concerns about students' learning, and (6) worries about being infected. All types of physical exercise were significantly associated with improvement in self-reported mental health during the COVID-19 outbreak. Specific types, intensities, durations, and frequencies of physical exercise might be more effective than others for reducing the mental health burden during home quarantine and social distancing. The largest associations were seen for home-based group entertainment exercise, Chinese traditional sports, and popular sports, as well as exercise with a duration of 30-60 min, exercise at frequencies of three to five times per week and a total of 120-270 min of moderate-intensity exercise per week during the COVID-19 outbreak.

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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

YM and YN: conceptualization. YW and YN: methodology and writing—original draft preparation. YW, YM, and JZ: formal analysis. JL, TL, CZ, and CL: investigation. YN, YM, and JZ: writing—review and editing. YW: project administration. All authors made relevant contributions to and approved the final manuscript.

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Defense Mechanisms and Borderline Personality Organization Among COVID-19 Believers and Non-believers During Complete Lock-Down

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The aim of the current study was to investigate whether a specific social perception of the pandemic—believing or not in COVID-19—predicts borderline personality organizations and whether this relationship is mediated by more primitive maladaptive mechanisms—splitting, denial, and dissociation. The online study included 720 organization aged 25–45. Participants were diverse in terms of place of residence, being in a relationship, and education level. Approximately 30% of the general population reported not believing in the COVID-19 pandemic. Non-believers scored slightly higher on borderline symptoms and used more maladaptive defense mechanisms than believers. Individuals who deny COVID-19 are more likely to show characteristics of borderline personality organization. Splitting is an important mechanism in this relationship.

Keywords: borderline personality organization, COVID-19 belief, denial, dissociation, splitting

INTRODUCTION

Perceptions and attitudes toward negative and powerful life events can be related to the type of defense mechanisms an individual employs and the level of functioning of the ego (1). To many people a sudden shift in their everyday lives due to the recent COVID-19 pandemic and lock-down could have been a traumatizing event and may have triggered the use of maladaptive defense mechanisms (2, 3). That could be especially true among individuals with weaker ego, who use more maladaptive defense mechanisms (4). It is plausible that the way an individual perceives reality under stressful events could enhance pathological functioning if he/she uses maladaptive defense mechanisms. A highly stressful event like the pandemic can increase support for the ideology, convictions and possibly defense mechanisms that were already embraced before the stressor appeared (5, 6).

Defense mechanisms are related to the way people process everyday events. The way people interpret certain situations creates behavioral patterns, and the greater the cross-situational consistency, the more that constitutes a certain personality characteristic (7, 8). If a situation is strong [meaning salient, guiding behaviors so that people construe it in similar ways, (9, 10), the way people perceive it predicts certain behaviors to a greater extent than just personality characteristics (11, 12). Hence, in line with socially constructed perspective, questions in psychology should be answered not only in regard to psychological inner states (e.g., experienced feelings or dispositional

factors), but also with consideration of an individual in interaction with a situational context (13, 14). In line with this perspective, psychopathology and mental disorder can be constructed by specific situational perceptions of an individual. Thus, perhaps, if an individual experiences chronic stressors (such as the prolonged pandemic situation) and continually chooses maladaptive defense mechanisms, it can lead to the development of psychopathological symptoms. Furthermore, if a person who is already displaying mental health problems finds themselves in such a situation, it can reinforce the choice of such defenses.

The aforementioned assumptions could shed different light on the borderline personality organization during pandemic. Those with borderline personality organization process reality using mainly splitting, primitive denial, or projective identification (4, 15), also individuals diagnosed with borderline personality disorder (BPD) report using a maladaptive and image-distorting defense style more often as compared to non-BPD individuals (16). The function of maladaptive mechanisms is in most cases an adaptation to stressful, traumatic or unbearable events (17). Among them, a few have a distinct function to either block the events from awareness, like denial or dissociation, which is an emotional detachment from reality, or to deal with the ambiguity or uncertainty of events but polarizing views—that is mainly splitting (4, 18). For these reasons, we tested whether believing or not in COVID is associated with borderline personality symptoms and whether that is related to using the abovementioned more primitive maladaptive defense mechanisms.

In general, we propose that particular perceptions of an event may be linked to psychopathology. In the current study we were curious whether a specific social perception of the pandemic, namely rejecting the idea of the COVID pandemic during a complete lock-down, is related to deeper psychological dysfunction in the form of utilizing those maladaptive defense mechanisms that are commonly seen in BP symptomatology. These mechanisms all aim to block immediate reality and include dissociation, denial and splitting, with the latter involving also a fundamental lack of integration and black-and-white thinking (19).

METHOD

Participants and Procedure

A total of 720 volunteers aged 25–45 ($M = 34.37$, $SD = 5.71$) participated in this study (71.1% female, 27.9% male; 1 person refused to state their gender). The sample was not fully representative for the Polish population given the restricted age range and gender distribution, however, it was diverse in terms of place of residence, being in a relationship, and education level (Table 1). Sixty four (8.9%) respondents reported being currently in psychotherapy, and 49 (6.8%) reported taking medication prescribed by a psychiatrist. All participants were recruited by a Polish online research pool Ariadna. Convenience sampling was applied, given that only people who chose to register for the

research pool were able to take part (an invitation was sent to them by the pool mailing system).

The study was conducted in October–November 2020 in Poland, during a period of the “second wave” of the COVID-19 pandemic. At that time, the number of cases had been increasing from moderate to high (20). No vaccines were then available in Poland. The study was a part of a larger research project, but the analyses reported here are completely novel. It was conducted online and consisted of a series of self-report questionnaires.

Statistical power was calculated with G*Power 3.1 analyses (21). According to this, our sample size allowed for detection of an effect of partial R^2 increase of .05, $\alpha = 0.05$ with a power of 0.99. All analyses were conducted using IBM SPSS 26 for Windows with Andrew F. Hayes 3.4.1 macro for SPSS (22).

Measures

To measure borderline symptoms we used the Polish adaptation¹ of the Borderline Personality Inventory [BPI; (23)]. Its short version consists of 22 true-false items which refer to the diagnostic criteria of borderline personality disorder. The BPI identifies patients with borderline personality organization in high agreement with the clinical criteria as well as with the Gunderson's criteria for BPD. It is recommended as an instrument to assess the borderline personality organization, BPD, and borderline features in disorders from Axis I and II (24). However, it ought to be noted that the measure is self-report based and provides insight into symptomatology, but it cannot be considered equivalent to observer-based clinical diagnosis. The borderline personality indicator was created by summing the “true” responses, each such response is 1 point. The cutoff point for borderline personality is 10 points. The measure had a satisfactory reliability in our study (Cronbach's $\alpha = 0.86$).

To measure defense mechanisms, the Polish version (1) of Defense Style Questionnaire-40 [DSQ-40; (25)] was used. It assesses 20 defense mechanisms and consists of 40 items (two items per each mechanism). Participants responded by indicating how much they agree with each item using a 9-point Likert scale (1 = *completely disagree*, 9 = *completely agree*). In the current study, three mechanisms were of interest: splitting (Cronbach's $\alpha = 0.48$), denial (Cronbach's $\alpha = 0.50$) and dissociation (Cronbach's $\alpha = 0.51$).

To measure believing in COVID-19 we used a question asking “Do you believe in the global coronavirus pandemic of SARS-CoV-2?” The participants marked their answers on a yes-no scale.

RESULTS

Results showed that there were more believers ($N = 504$, 70%) than non-believers ($N = 216$), $\chi^2(1) = 115.20$, $p < 0.001$. Comparison between believers and non-believers indicated that number of men and women was similar. However, believers were lower on borderline symptoms scale, less often exceeded the cutoff for the borderline organization

¹Cierpialkowska L. Adaptacja Kwestionariusza Osobowosci Borderline F. Leichsenringa [Polish adaptation of F. Leichsenring Personality Inventory] (2001).

TABLE 1 | Demographic and psychometric characteristics of believers and non-believers; for numeric variables means and standard deviations in parenthesis with *t*-tests (or Welch tests) and Cohen's *d* were presented and for dichotomous variables (sex, compliance, borderline > 10) number and percentage in parenthesis with χ^2 test and Cramer's *V* was presented.

Variable	Believers <i>N</i> = 504 <i>M</i> (SD) or <i>N</i> (%)	Non-believers <i>N</i> = 216 <i>M</i> (SD) or <i>N</i> (%)	<i>t</i> or χ^2	<i>p</i>	Cohen's <i>d</i> or Cramer's <i>V</i>
Age	34.68 (5.84)	33.66 (5.33)	2.27	0.023	0.18
Sex (women)	355 (70.60)	163 (75.50)	1.79	0.18	0.05
Compliance (yes)	491 (97.40)	164 (75.90)	85.60	<0.001	0.34
Borderline	5.06 (4.30)	5.98 (4.93)	−2.35	0.019	−0.20
Borderline > 10	54 (10.70)	35 (16.20)	4.20	0.040	0.08
Anxiety	14.12 (3.93)	13.95 (3.80)	0.53	0.59	0.04
Depression	13.36 (4.10)	13.31 (4.17)	0.14	0.88	0.01
Denial	6.89 (3.19)	7.62 (3.27)	−2.79	0.005	−0.22
Dissociation	7.31 (3.06)	8.08 (3.39)	−2.98	0.003	−0.24
Splitting	8.96 (3.62)	9.92 (3.76)	−3.22	0.002	−0.26

TABLE 2 | Coefficient in models testing relationship between believing vs. non-believing in COVID and borderline symptoms mediated through splitting, denial, and dissociation.

	Coeff	SE	<i>t</i>	<i>p</i>	95% CI	Stand. Coeff
Mediation through splitting						
Non-believing and splitting relation	0.96	0.29	3.22	0.001	0.37, 1.54	0.26
Splitting and borderline relation controlling for non-believing	0.35	0.04	8.17	< 0.001	0.27, 0.44	0.29
Non-believing and borderline relation controlling for splitting	0.56	0.35	1.60	0.108	−0.12, 1.26	0.12
Mediation through denial						
Non-believing and denial relation	0.73	0.26	2.79	0.005	0.21, 1.24	0.22
Denial and borderline relation controlling for non-believing	0.15	0.05	2.94	0.003	0.05, 0.25	0.10
Non-believing and borderline relations controlling for denial	0.80	0.36	2.18	0.029	0.08, 1.51	0.17
Mediation through dissociation						
Non-believing and dissociation relation	0.76	0.25	2.98	0.003	0.26, 1.27	0.24
Dissociation and borderline relations controlling for non-believing	0.17	0.05	3.22	0.001	0.06, 0.27	0.12
Non-believing and borderline relation controlling for dissociation	0.78	0.36	2.13	0.033	0.06, 1.50	0.17

diagnosis and used less Denial, Dissociation and Splitting mechanisms than non-believers. **Table 1** presents means and frequencies of study variables in believers and non-believers with comparison statistics.

Further analysis showed that greater Borderline symptoms were related to Splitting, $r = 0.30$, $p < 0.001$, Denial, $r = 0.12$, $p = 0.002$ and Dissociation, $r = 0.13$, $p = 0.001$, and Dissociation and Denial were closely related to each other, $r = 0.62$, $p < 0.001$ and less strongly to Splitting (Dissociation, $r = 0.26$, $p < 0.001$, Denial, 0.34 , $p < 0.001$). Next, three separate mediation models were tested using PROCESS version 3.4.1. macro (22), where non-believing (0—believing; 1—non-believing) was the predictor of borderline symptoms and one of the three defense mechanisms was the mediator. In **Table 2**, coefficients for each model are presented.

The total effect of Non-believing on Borderline symptoms was significant, $B = 0.91$, $SE = 0.36$, $t = 2.49$, $p = 0.013$, 95% CI [0.19, 1.63], $\beta = 0.20$. Results showed that all three mechanisms partially mediated this effect, Splitting, $B = 0.34$, $SE = 0.11$, 95% CI [0.13, 0.56], $\beta = 0.07$, Dissociation, $B = 0.13$, $SE = 0.06$, 95% CI [0.02, 0.27], $\beta = 0.03$, Denial, $B = 0.11$, $SE = 0.05$, 95% CI

[0.01, 0.23], $\beta = 0.02$. The direct effect became non-significant when Splitting was included, but was still significant when Denial and Dissociation effects were accounted for.

DISCUSSION

The current study shows that ~30% of the sample reported not believing in the COVID pandemic. Non-believers scored slightly higher on borderline symptoms ($d = 0.20$) and used more maladaptive defense mechanisms than believers. The association between borderline personality symptoms and COVID denial became non-significant after controlling for both their associations with splitting (but not with denial and dissociation), highlighting the possibility that splitting is responsible for the link between the two. These findings confirm that splitting is a psychological defense that is considered a central marker of borderline personality disorder symptoms (26).

The COVID-19 virus is life-threatening, and the pandemic constitutes both an intensive and chronic stressor. In such demanding situations the ego's defenses may weaken or even

collapse, leading to decompensation (27–29). Such a failure could result in extreme anxiety and the ultimate defense of the ego from annihilation, which could be dissociation. It is characterized by feeling cut off from oneself, seeing oneself from outside one's body, or feelings of unreality (4). To prevent this state and defend against what one experiences as an overwhelming event or trauma, the ego might use splitting (30). This is an exact defense mechanism against extreme anxiety that is related to dissociation and death. Patients compartmentalize memory: one part of the ego may stay in touch with the non-disturbing reality while the other one may lose this contact and reject all aspects that are viewed as too distressing. The individual might even construct an alternative, more desirable reality (30).

Maintaining this kind of maladaptive coping across time may lead to an inability to create an abiding sense of self and/or significant impairments in the ego (31). The ego is poorly developed or with unstable self-image as the ego is built “between two worlds.” In this sense, perception of social events may “create” the psychopathology, and further weaken the unstable ego leading to deepening the symptoms of BPD. That notion has to be explored however in longitudinal studies. In a manner of speaking, if the environment is traumatic and full of “strong” events, people may, by using more primitive defenses, “build up” personality disorder. Investigating such idea might have great implications for clinical work—changing the environment and replacing defense mechanisms, which become non-adaptive in a new situation, may lead to improvement in PDs. The described above association between denying or minimizing the event and borderline personality organization may go beyond the COVID-19 related phenomena and be universal. As Minikin (32) shows, intolerance feeds regressive defenses such as splitting, which relates to alienation. The latter is viewed as the root cause of all mental and social distress.

Some limitations require consideration. While the current investigation clearly establishes a relationship between denial of COVID and increased symptoms of borderline personality symptomatology, these results are correlational and cross-sectional and cannot address causality. The borderline personality symptomatology was assessed only with a self-report questionnaire, which while reliable does not allow clinical diagnoses. The participants were recruited by a research pool, enabling us to gather a diverse sample in terms of place of residence, age or professional background, however, the study cannot be considered representative for the Polish population. Additionally, our question regarding belief in the COVID-19 pandemic was straightforward but was not able to assess any nuances in regard to this belief. Future studies would likely

benefit from a more thorough assessment of COVID-19 beliefs. Notwithstanding these limitations, the current findings indicate that those individuals who deny COVID-19 are more likely to show characteristics of borderline personality symptomatology and that splitting is an important mechanism in this relationship.

DATA AVAILABILITY STATEMENT

The datasets presented in this study are published open access and can be found online. They can be downloaded from: <http://apsycholab.pl/downloads/>.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AZ: conceptualization, methodology, investigation, resources, writing—original draft, writing—review and editing, supervision, and project administration. IN: investigation, resources, writing—original draft, writing—review and editing, and project administration. MB-Z: investigation, writing—original draft, and writing—review and editing. JR: methodology, formal analysis, investigation, data curation, writing—original draft, and visualization. IK: investigation, resources, and writing—original draft. AJ and AP: writing—original draft and writing—review and editing. All authors contributed to the article and approved the submitted version.

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Infodemic vs. Pandemic Factors Associated to Public Anxiety in the Early Stage of the COVID-19 Outbreak: A Cross-Sectional Study in China

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Introduction: Every outbreak of an epidemic or pandemic disease is accompanied by the tsunami of information, which is also known as the infodemic. Infodemic makes it hard for people to find trustworthy sources and reliable guidance when they need it, and causes social panic about health, widens the gaps between races and regions, and even brings the social chaos all over the world. While most researchers and related parties made efforts to control the inaccurate information spreading online during the COVID-19 pandemic, the infodemic influence caused by the overload of accurate information were almost or completely ignored, and this will hinder the control of infodemic in future public health crises. This study aims to explore the infodemic vs. pandemic influence on people's psychological anxiety across different media sources in the early stage of the COVID-19 outbreak in China.

Methods: A cross-sectional study using online survey method was conducted by a data-collection service provider in April 2020. A total of 1,117 valid samples were finally collected from 5,203 randomly invited members via webpages and WeChat. The sample distribution covered the 30 provincial administrative divisions of mainland China.

Results: Hierarchical regression analysis for the potential pandemic sources and infodemic sources of psychological anxiety showed that the infodemic factors of attention to the coronavirus information ($\beta = 0.154$, $p < 0.001$) and commercial media exposure ($\beta = 0.147$, $p < 0.001$) is positively related to the level of anxiety. Statistics indicated that influence of the infodemic factors is over and above that of the pandemic factors ($\Delta R^2 = 0.054$, $F = 14.199$, and $p < 0.001$). Mediation analysis showed that information overload ($B = 0.155$, Boot SE = 0.022, and 95% Boot CI [0.112, 0.198]) mediates the link between attention to coronavirus information and anxiety; both information overload ($B = 0.035$, Boot SE = 0.014, and 95% Boot CI [0.009, 0.062]) and media vicarious traumatization ($B = 0.106$, Boot SE = 0.017, and 95% Boot CI [0.072, 0.140]) mediate the link between commercial media exposure and anxiety.

Conclusion: This study suggested that the influence of infodemic with mixed accurate and inaccurate information on public anxiety does exist, which could possibly go beyond that of the pandemic. Information overload and vicarious traumatization explain how infodemic may be associated to public anxiety. Finally, commercial media could be a major source of infodemic in the Chinese media context. Implications for the related parties were discussed.

Keywords: infodemic, COVID-19, anxiety, information overload, vicarious trauma, commercial media, urban governance

INTRODUCTION

Background

At the beginning of 2020, the whole world fell into an emergent public health crisis brought by the COVID-19 pandemic. Accompanied with the outbreak of the COVID-19 was the tsunami of the disease-related information, which is known as the infodemic (1). In this crisis, media plays an important role in people's information acquisition. All media outlets were unprecedentedly active, reaping countless high searching, reading, and forwarding volumes. However, some media outlets have also been criticized for providing false information, inflammatory views, and even unethical content. Although the pandemic has been under well-control in some countries, a series of social, psychological, and ethical issues brought about by the infodemic still worth to be reconsidered.

Infodemic is a phenomenon described as an over-abundance of information—some accurate and some not—that makes it hard for people to find trustworthy sources and reliable guidance when they need it (2). The World Health Organization declared that besides the pandemic threat originated by the COVID-19 virus, an infodemic has been generated by a large amount of information available on the matter, as well as by the difficulty to sort the veracious information from the false (2). Although the outbreak of SARS in 2003, H1N1 in 2009, and MERS in 2012 were all accompanied by rumors and false information, creating different degrees of social panic, the COVID-19 pandemic has developed unprecedented trend of infodemic with the emerging information technology, which was defined as “the first true social-media infodemic” (3). Social media is considered a powerful tool for sharing health information related to pandemic risks (4, 5). After the COVID-19 outbreak, 70–80% of the Chinese users reported an increase in the use of WeChat (6, 7).

Infodemic, including dissemination of conflicting or unclear messages, misinformation, rumors, and conspiracy theories, can profoundly cause public anxiety and social panic, affect public health communication, diminish preventive measures, impede effective crisis management, widen the gaps between races and regions, and even bring the social chaos all over the world (8–12). The heightened distress by the infodemic can also cause individuals' irrational behaviors in the crisis, such as health information avoidance, spread of misinformation, overuse of the healthcare services, panic purchases, in compliance with preventive measures (such as physical distancing, mask wearing, and vaccination) (13–17). The World Health Organization, the

United Nations, the United States Centers for Disease Control and Prevention, and many other organizations had all engaged in fighting against the infodemic by debunking of false information, stopping the spread of rumors, providing the population with reliable data and updated news about COVID-19 (18–20). Technology industries including Google, Amazon, Facebook, YouTube, Microsoft, and Twitter also implemented restrictions on publishing pandemic-related content and removed medically disproved claims (21–24).

Interesting enough, existing studies seem suggest that online users have an adequate e-health literacy and can effectively filter the false information in emergent public health crises. Studies showed that users can critically evaluate the source of the health information received and are capable to discriminate between reliable and unreliable content, and they place higher trust in the medical professionals and scientists than the mass media and social media, and they also rated the authorities' social media channels as more trustworthy than the user-generated content (25, 26). Big data analysis also showed that information from questionable sources or false information posted on social media only represents a small fraction compared to the reliable or science-based ones (27). Researchers claimed that there is a higher potential of true information to capture more user engagement (28). True information was also found to circulate more, reach a higher level of diffusion, spread more quickly, and have a longer lifetime than false information (29, 30). These suggest that false information dissemination may not be the only cause of infodemic and public anxiety.

Infodemic vs. Pandemic Factors of Public Anxiety

Previous studies have shown that people generally have varying degrees of anxiety in the context of public health emergencies. Uncertainty situations make people more vulnerable to mental and psychological distress. In the early stage of the COVID-19 outbreak, especially in China, people were exposed to unknown threats, and highly uncertain about the infectivity, susceptibility, and treatment methods of the COVID-19. A study showed that more than half of the Chinese participants suffered from psychological distress, anxiety, depression, and stress at moderate to severe levels (31). Perceived risk of infection is one of the most direct factors that cause individual anxiety and fear. Studies have revealed that perceived risk of COVID-19 significantly associated with anxiety-related feelings such as sleeping disorder, stress, worry, and disruption of daily life (32–34).

Besides the pandemic factors, public anxiety levels are also largely influenced by the infodemic factors, especially in the highly developed information technology era. Researchers found that the excessive social media use leads to increased levels of stress, anxiety, and vicarious trauma (35). An online survey indicated a positive link between information exposure during the COVID-19 pandemic and the occurrence of anxiety and insomnia symptoms, and the strength of the association increases with the duration of the media exposure (12, 36). Major information sources of the COVID-19 pandemic not only involve social media, but also traditional media (12). Experts and scholars criticized that social media as well as traditional mass media were disseminating inaccurate information during the COVID-19 pandemic, and even most extreme pictures found elsewhere sending the wrong message were being used in many mainstream newspapers and TV reports (9).

Information Overload

Information overload represents a state in which an individual's efficiency in using information in their work is hampered by the amount of relevant, and potentially useful, information available to them. The feeling of overload is usually associated with a loss of control over the situation, and sometimes with feelings of being overwhelmed (37). Information is a double-edged sword in the COVID-19 pandemic. On the one hand, effective communication of facts helps people to obtain adequate risk perceptions and make adaptive health behavior, while on the other hand, overloaded information can also impose strains on crisis management (26, 38, 39). Studies showed that as people are intensively exposed to negative information about a crisis, their levels of anxiety and other unpleasant emotions could be triggered and elevated for an extended period (40–43), especially when their personal experience with the disease is limited (25, 44, 45).

Media Vicarious Traumatization

Vicarious trauma describes the trauma experiences people have after being exposed to others' trauma stories and having witnessed the pain, fear, and terror that traumatized survivors have endured (46, 47). Media could be another source of vicarious trauma (48), when audiences indirectly experience the traumatic events *via* the vividly presented videos, pictures, and texts exposed by the media. Studies showed that obtaining more informational support *via* social media increased users' vicarious trauma levels (35). When the information and media content are perceived as threatening, aversive emotions can be elicited (49–52), and when information is contradictory or uncertain, the distress may be even more elevated (53, 54). Extensive research indicated that consuming media coverage to the natural or humanmade disasters typically associates with increased incidences of post-traumatic stress disorder (PTSD), anxiety, and depression (55–58).

Goal of This Study

Most researchers and related organizations engaged in dealing with the control of false information dissemination online (such as misinformation, fake news, rumors, conspiracy theories)

as well as their negative influence on public mental health and health related behaviors during the COVID-19 pandemic. However, a key question remained was that “is the false information spreading the only cause of public anxiety?” A critical part was almost or completely ignored in the existing studies and countermeasures, which is, the infodemic caused by the over-abundance of the mixed inaccurate and accurate information disseminated by the social media, mass media, and even government official media.

This study will focus on the influence of infodemic across different media sources on people's anxiety in the early stage of the COVID-19 outbreak in China. It aims to answer the following three research questions:

- will the infodemic factors vs. pandemic factors significantly associated with people's anxiety?
- what are the underlying mechanisms of the impact of infodemic on people's anxiety; that is, how information overload and media vicarious traumatization mediate the impact?
- what are the roles played by the three main information sources in the Chinese media context (i.e., government official media, commercial media, and social media) in the infodemic?

METHODS

Recruitment

The data were collected online by a sample service provider (i.e., Changsha Ranxing IT Ltd.), who owns one of the biggest online sample with more than 2.6 million members all over China. The survey was conducted by randomly inviting 5,203 members from the 30 provinces of mainland China *via* webpages and WeChat in April, 2020. A total of 1,342 members responded to the invitation. Among them, 225 invalid responses were systematically or manually eliminated by the sample service provider, and the final valid responses received were 1,117 with a response rate of 21.5%. Cities mostly influenced by the COVID-19 in the early stage of the outbreak were all covered, and the regional distribution of the samples were as follows: Wuhan (9%) and other cities (14%) of Hubei Province; Guagnzhou (6%) and Shenzhen (6%) of Guangdong Province; Wenzhou (7%) of Zhejiang Province; Beijing (7%); Shanghai (6%); Chongqing (7%); and other cities of the other 24 provinces (38%). Participation of the survey was anonymous and voluntary.

Ethical Consideration

The protocol of this study was approved by the Institutional Review Board of Shanghai Jiao Tong University (No: H20200381). The data were treated with confidentiality and the results did not identify the participants personally.

Participants

Less than half of the participants are male (45.9%) and 54.1% are female. A majority age between 18 and 40 years old (85.5%). Almost all of them are in good health condition (98%). During the pandemic, 23.0% of the participants stayed in Hubei Province, and 77% stayed in other provinces; most of the

TABLE 1 | Characteristics of the participants.

Demographics	Percentage	<i>n</i>
Gender		
Male	45.9%	513
Female	54.1%	604
Age		
<18	4.1%	46
18–25	30.6%	342
26–30	22.6%	252
31–35	23.5%	263
36–40	9%	101
41–50	7.6%	85
>50	2.5%	28
Health condition (Mean = 3.92, SD = 0.72)		
Very poor	0.1%	1
Relatively poor	2.0%	22
Average	24.0%	268
Relatively good	53.6%	599
Very good	20.3%	227
Place of residence		
Hubei province	23.0%	257
Other provinces	77.0%	860
Accommodation		
Stay alone	2.3%	26
Stay with family/friends	97.7%	1,091

N = 1,117.

SD, standard deviation.

participants stayed with family members or friends (97.7%), and only 2.3% stayed alone. Detailed participant characteristics are shown in **Table 1**.

Measurements

Psychological Anxiety

The psychological anxiety questionnaire was adapted from Zung's Self-Rating Anxiety Scale (SAS) (59). Participants were asked to rate their level of anxiety in the early stage of the COVID-19 outbreak on a 5-point Likert scale (1 = completely disagree, 5 = completely agree) with three items, including "I feel nervous and anxious due to the coronavirus pandemic," "I have sleeping problems during the coronavirus pandemic," and "I feel panicky and cannot sit still easily during the coronavirus pandemic." Higher scores indicate higher levels of psychological anxiety. Cronbach's alpha of this questionnaire is 0.83. Correlations between items 1 through 3 with the total score are 0.85 ($p < 0.01$), 0.88 ($p < 0.01$), and 0.87 ($p < 0.01$), respectively.

Pandemic Factors

Participants were asked to rate their perceptions to the COVID-19 pandemic in the early stage of the outbreak. Four indicators were adopted from the widely used measurements for the Health Belief Model variables (60, 61): (a) perceived risk of oneself getting infected by coronavirus (from 0 to 100%), (b)

perceived risk of people around getting infected by coronavirus (from 0 to 100%), (c) worry about oneself getting infected by coronavirus (1 = not at all, 5 = very much), and (d) worry about people around getting infected by coronavirus (1 = not at all, 5 = very much).

Infodemic Factors

Participants were asked to rate their information consumption in the early stage of the COVID-19 outbreak, which includes five indicators: attention to coronavirus information and attention to information irrelevant to the coronavirus on 5-point Likert scales (1 = hardly ever, 2 = less than an hour, 3 = 1–3 h, 4 = 3–5 h, 5 = more than 5 h); exposure to different media sources including the government official media (e.g., CCTV, People's Daily, Hubei Daily), commercial media (e.g., The Paper, Sanlian Life Week, Caixin), and social media (e.g., WeChat, Weibo, TikTok) on 5-point Likert scales (1 = never, 5 = often).

Information Overload

Information overload was measured by the questions adapted from Zhang and colleagues' Information Overload Questionnaire on a 5-point Likert scale (1 = completely disagree, 5 = completely agree) including five items, for example, "I find that only a small part of the coronavirus information is relevant to my needs," "I find that I am overwhelmed by the amount of coronavirus information I have to process on a daily basis," and "There is too much information so I find it a burden to handle" (62). Cronbach's alpha of this questionnaire is 0.76.

Media Vicarious Traumatization

Media vicarious traumatization was measured by the questions adapted from the Vrkleviski's Vicarious Traumatization Scale (VTS) on a 5-point Likert scale (1 = completely disagree, 5 = completely agree) with seven items, including "I was exposed to distressing news and experiences about coronavirus *via* media," "It is hard to stay positive and optimistic given some of the coronavirus information I get from the media," and "I find myself thinking about distressing coronavirus news on media" (63). Cronbach's alpha of this questionnaire is 0.78.

Statistical Analysis

All statistical analysis were performed using SPSS statistics (v25, IBM, USA). Descriptive analysis concerning the minimums, maximums, means, and standard deviations of the main variables were reported. To examine the influences of the pandemic and infodemic factors on anxiety, a hierarchical regression analysis was conducted including the control variables (i.e., gender, age, health condition, accommodation, and place of residence), the pandemic factors (i.e., risk of oneself, risk of people around, worry about oneself, worry about people around), and the infodemic factors (i.e., attention to coronavirus information, attention to coronavirus-irrelevant information, government official media exposure, commercial media exposure, and social media exposure) in three blocks, respectively. Improvements in model fit was indicated by the R^2 change in each block. To analyze the underlying mechanisms of the influence of the infodemic factors, mediational analyses using Process Macro model 4 (64)

TABLE 2 | Descriptives of the main variables.

	Minimum	Maximum	Mean	SD
Psychological anxiety	1	5	2.83	0.98
Pandemic factors				
Risk_oneself	0	100	41.67	17.71
Risk_people around	0	100	44.25	20.61
Worry_oneself	1	5	3.49	0.71
Worry_people around	1	5	3.38	0.84
Infodemic factors				
Attention_coronavirus information	1	5	3.02	0.83
Attention_coronavirus-irrelevant information	1	5	2.87	1.01
Government official media	1	5	4.01	1.10
Commercial media	1	5	2.73	1.15
Social media	1	5	4.24	0.93
Information overload	1	5	2.94	0.79
Media vicarious traumatization	1.43	5	3.27	0.66

N = 1,117.

SD, standard deviation.

were conducted. Direct and indirect effects were reported with their 95% confidence intervals.

RESULTS

Descriptives

Descriptives of the statistics are shown in **Table 2**. Psychological anxiety of the participants in the early stage of the pandemic is relatively low with the mean score of 2.83 out of 5. Among the pandemic factors, the average perceived risk of oneself getting infected is 41.67%, and the average perceived risk of people around getting infected is 44.25%. The mean score of worry about oneself getting infected is 3.49, and the mean score of worry about people around getting infected is 3.38. Among the infodemic factors, the mean score of attention to coronavirus information is 3.02, and the mean score of attention to coronavirus-irrelevant information is 2.87. Media sources exposed to the participants from the most frequent to the least frequent are social media (mean score is 4.24), government official media (mean score is 4.01), and commercial media (mean score is 2.73). The mean score of information overload is 2.97. The mean score of media vicarious traumatization is 3.27.

Regression Analysis for the Pandemic and Infodemic Factors of Anxiety

A hierarchical regression was conducted to analyze the pandemic and infodemic factors on psychological anxiety, with the control variables entered to the first block, the pandemic factors entered to the second block, and the infodemic factors entered to the third block. Results (see **Table 3**) showed that among the control variables, age ($\beta = 0.095$, $p < 0.01$), health condition ($\beta = -0.148$, $p < 0.001$), and accommodation ($\beta = 0.075$, $p < 0.05$) are significantly correlated to anxiety. In specific, participants who are older, in poorer health condition, or staying alone

TABLE 3 | Hierarchical regression for the pandemic and infodemic factors of anxiety.

	<i>B</i>	<i>SE</i>	β	<i>t</i>	<i>p</i>
Control variables					
Gender	0.079	0.058	0.040	1.366	0.172
Age	0.065	0.020	0.095**	3.180	0.002
Health condition	-0.201	0.040	-0.148***	-5.012	0.000
Accommodation	0.485	0.191	0.075*	2.541	0.011
Place of residence	0.058	0.069	0.025	0.844	0.399
$\Delta R^2 = 0.043$ ($F = 9.870$, $p < 0.001$)					
Pandemic factors					
Risk_oneself	0.003	0.001	0.094**	2.622	0.009
Risk_people around	0.000	0.001	-0.011	-0.295	0.768
Worry_oneself	0.125	0.025	0.180***	5.022	0.000
Worry_people around	0.023	0.022	0.039	1.048	0.295
$\Delta R^2 = 0.062$ ($F = 19.073$, $p < 0.001$)					
Infodemic factors					
Attention_coronavirus information	0.182	0.035	0.154***	5.174	0.000
Attention_coronavirus-irrelevant information	-0.023	0.028	-0.024	-0.849	0.396
Government official media	-0.016	0.027	-0.018	-0.598	0.550
Commercial media	0.126	0.026	0.147***	4.874	0.000
Social media	0.044	0.030	0.042	1.479	0.140
$\Delta R^2 = 0.054$ ($F = 14.199$, $p < 0.001$)					

N = 1,117.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

B, unstandardized regression coefficient; *SE*, standard error; β , standardized regression coefficient; *t*, value of the *t*-test statistic; *p*, probability; ΔR^2 , multiple correlation squared changed; *F*, Fisher's *F* ratio.

are more anxious than their counterparts. Gender and place of residence are not correlated to anxiety. Variance explained by the control variables (ΔR^2) is 0.043 ($F = 9.870$, $p < 0.001$). Among the pandemic factors, perceived risk of oneself getting infected ($\beta = 0.094$, $p < 0.01$) and worry about oneself getting infected ($\beta = 0.180$, $p < 0.001$) are positively correlated to anxiety after controlling for the effects of the control variables, while perceived risk of people around and worry about people around getting infected are not significantly correlated to anxiety. Variance uniquely explained by the pandemic factors (ΔR^2) is 0.062 ($F = 19.073$, $p < 0.001$). Among the infodemic factors, attention to the coronavirus information ($\beta = 0.154$, $p < 0.001$) and commercial media exposure ($\beta = 0.147$, $p < 0.001$) are positively related to anxiety after controlling for the effects of the control variables and the pandemic factors, while attention to coronavirus-irrelevant information, government official media exposure, and social media exposure are not significantly related to anxiety.

The hierarchical regression analysis showed that variance uniquely explained by the infodemic factors (ΔR^2) is 0.054 ($F = 14.199$, $p < 0.001$). It also indicated a unique contribution of the infodemic factors on anxiety over and above that of the pandemic factors. In other words, statistics supports that the influence of the infodemic factors are beyond that of the pandemic factors in increasing psychological anxiety.

Mediational Analysis of Information Overload and Media Vicarious Traumatization

Since the above analysis indicates that attention to coronavirus information and commercial media exposure are the two key infodemic factors, the underlying mechanisms of these two factors was further explored with mediational analyses.

A mediational analysis was firstly conducted for the effect of attention to coronavirus information on anxiety (see **Figure 1**). Results showed that when information overload is treated as the mediator, the mediation effect is not significant ($B = 0.025$, Boot $SE = 0.018$, and 95% Boot CI $[-0.011, 0.059]$), and there is only a direct effect of attention of coronavirus information on anxiety ($B = 0.232$, $SE = 0.030$, and 95% CI $[0.174, 0.290]$). When media vicarious traumatization is treated as the mediator, the mediation effect is significant ($B = 0.155$, Boot $SE = 0.022$, and 95% Boot CI $[0.112, 0.198]$), and the direct effect of attention of coronavirus information on anxiety is also significant ($B = 0.102$, $SE = 0.028$, and 95% CI $[0.047, 0.157]$). That is, the effect of attention to coronavirus information on anxiety is mediated by media vicarious traumatization.

A mediational analysis was secondly conducted for the effect of commercial media exposure on anxiety (see **Figure 2**). Results showed that when information overload is treated as the mediator, the mediation effect is significant ($B = 0.035$, Boot $SE = 0.014$, and 95% Boot CI $[0.009, 0.062]$), and the direct effect of commercial media exposure on anxiety is also significant ($B = 0.114$, $SE = 0.022$, and 95% CI $[0.071, 0.157]$). When media vicarious traumatization is treated as the mediator, the mediation effect is significant ($B = 0.106$, Boot $SE = 0.017$, and 95% Boot CI $[0.072, 0.140]$), and the direct effect of commercial media exposure on anxiety is also significant ($B = 0.042$, $SE = 0.020$, and 95% CI $[0.003, 0.082]$). That is, the effect of commercial media exposure on anxiety is mediated by both information overload and media vicarious traumatization.

DISCUSSION

This study focuses on the infodemic vs. pandemic influence on people's anxiety across different media sources in the early stage of the COVID-19 outbreak among the Chinese participants. In specific, it (a) explored the influence of infodemic vs. pandemic on people's anxiety, (b) explored the mediation effect of information overload and media vicarious traumatization, and (c) compared the differences in the roles of government official media, commercial media, and social media. Findings showed that pandemic factors of perceived risk of oneself getting infected and worry about oneself getting infected are positively related to the level of anxiety; infodemic factors of attention to coronavirus information and commercial media exposure are positively related to the level of anxiety; government official media exposure, social media exposure, and attention to coronavirus-irrelevant information were found to be the insignificant infodemic factors. More importantly, statistics also indicated that influence of the infodemic factors is beyond that of

the pandemic factors. Mediation analysis testing the underlying mechanisms of the infodemic influence showed that vicarious traumatization mediates the effect of attention to coronavirus information on anxiety; both information overload and media vicarious traumatization mediate the effect of commercial media exposure on anxiety.

The findings first suggest that the infodemic influence on people's anxiety with mixed accurate and inaccurate information does exist, which could possibly be more profound than that of the pandemic itself. During an emergent public health crisis, people are more inclined to acquire information in order to alleviate the sense of uncertainty (65), however, findings suggest that paying too much attention to the crisis information and being intensively exposed to certain types of media content about the crisis may exacerbate the anxious and stressful feelings. Findings of this study also indicated that even distractions from the coronavirus-irrelevant information, including entertainment, games, and daily news, do not effectively alleviate the anxiety. Thus, this further supports experts' opinions that infodemic is not only caused by the spreading of false information or rumors, accurate information routinely spread by different media outlets could also become potential sources of infodemic. On the one hand, it is important to increase the speed and width of spreading of information and scientific evidence from trustworthy sources, such as the public health officials, medical professionals, scientists, verified social media accounts, official reports, etc. The most crucial and official information should be communicated by these credible groups, in order to effectively lower the emotional taxing of the crisis (25). On the other hand, active citizenship against the spread of false information should also be advocated, knowing that users have the potential to be trained to debunk false information through scientific literacy cultivation (28).

Information overload and media vicarious traumatization were found to be the important underlying mechanisms explaining why and how infodemic may be associated with anxiety. When individuals are intensively exposed to the crisis information, it is inevitable to vicariously experience the traumatic contents, which will in turn, increase their level of anxiety. This problem is more salient in the case of commercial media exposure compared to the government official media exposure and social media exposure. Commercial media may not only trigger the distressed perception by the overloaded amounts of reports, but also bring about vicarious traumatization. During the pandemic in China, commercial media circulated vast amount of coronavirus information intensively, and such information were further pushed to their users continuously with the utilization of artificial intelligence based on algorithms and historical data. Thus, consumers of commercial media may passively receive overloaded coronavirus information that probably carries traumatic contents. While researchers have proposed the empathic style of communication and personal experience sharing as the infodemic countermeasure (66), our study suggested that such style could be inappropriate considering the vicarious traumatization effect of the media coverage. On the contrary, media should convey information to

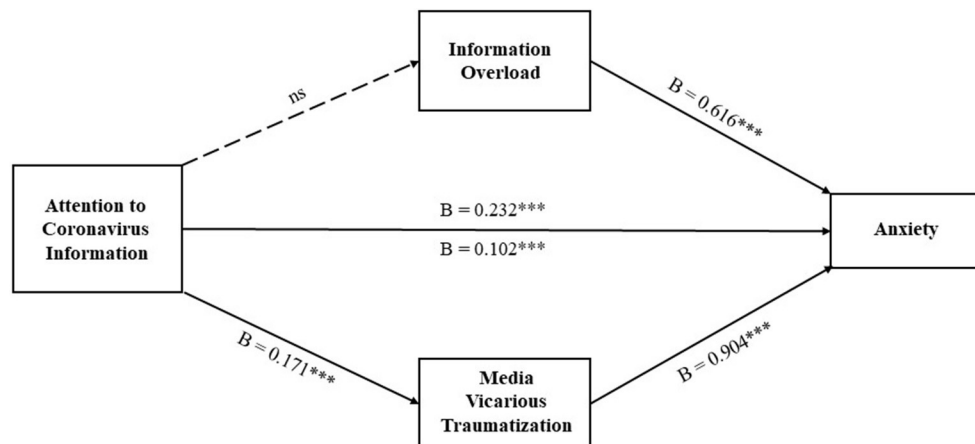


FIGURE 1 | Mediation analysis for the effect of attention to coronavirus information on anxiety. B, unstandardized regression coefficient; *** $p < 0.001$; ns, nonsignificant.

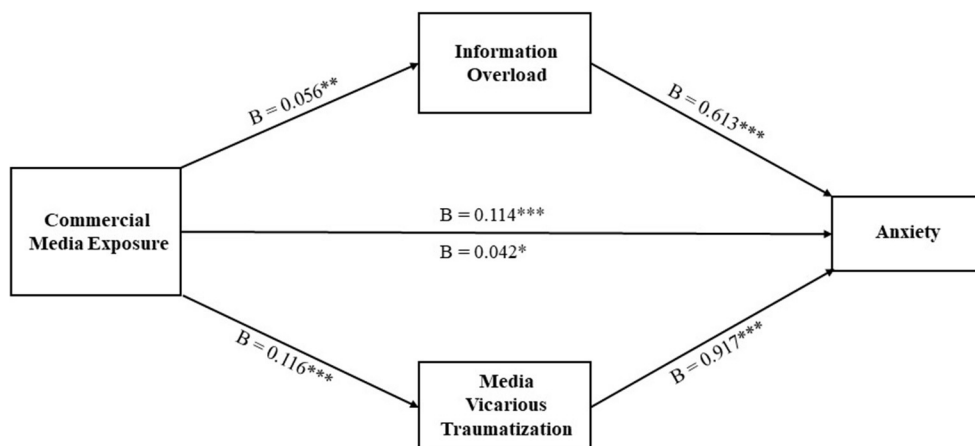


FIGURE 2 | Mediation analysis for the effect of commercial media exposure on anxiety. B, unstandardized regression coefficient; *** $p < 0.001$, ** $p < 0.01$, and * $p < 0.05$; ns, nonsignificant.

the public without sensationalizing the situation or providing disturbing images and videos so as to prevent bringing emotional trauma to the public.

Comparisons across information sources showed that commercial media could be a major source of infodemic in the Chinese media context. Commercial media coverages could directly and indirectly cause public anxiety by overloaded information output and vicarious traumatization. Such impact exists among the commercial media more obviously than other types of media, and this could be explained by the market-oriented nature and the report genres of the commercial media. Commercial media in China intend to focus on those vivid cases from the microscopic perspective, and their story-telling feature could more easily trigger the traumatic feelings of the audience. In the early stage of the COVID-19 outbreak, the commercial media were inclined to cover the contents such as the situation of the first-line treatment, the patients' and families' stressful experience, and how the Wuhan citizens were

expelled in other cities or countries, meanwhile, they tended to focus on the detailed and negative incisions from the patients, family members, and medical staff perspectives. Some typical examples include the article "Mother died in Wuhan isolation ward" released by Phoenix News on 28 January, 2020, the article "Wuhan Community under the pressure of epidemic: After the elderly died of high fever at home" released by Caixin on 29 January, 2020, and the article "When the hotel reception heard that I was from Wuhan, they immediately called the police" released by ThePaper on 28, January, 2020, and these articles went viral in only a few hours. In contrast, the government official media coverages in China are more neutral, macroscopic, and science-based, which mostly covered the authentic data, progress of the pandemic, and the government responses. Social media were usually found to be a major source of false information and rumors during crises in many studies, however, it is important to note that social media not only spread the crisis information, but also play a role in the health information

support as well as social and emotional support from family members, friends, and significant others (67, 68). This could be the reason why social media was not found to be a source of infodemic in the current study. Thus, commercial media together with other media outlets should actively mitigate infodemic and public anxiety during public health crises by avoiding overloaded crisis information reports and detailed trauma-related content. Governments could also direct public health policies to address the impact of media portals in their routine spreading of information in times of pandemics rather than merely dealing with false information (66).

CONCLUSION

This study gives insights for the in-depth understanding of the infodemic impact by analyzing the essential attributes of the infodemic from aspects of definition, information sources, communication mechanisms, and social psychological impact. The research findings provide valuable implications and suggestions for infodemic governance from the perspective of media practitioners, policy makers, and media consumers.

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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 Shanghai Jiao Tong University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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Generalized Anxiety Disorder, Depressive Symptoms, and Sleep Problem During COVID-19 Outbreak in Ethiopia Among Police Officers: A Cross-Sectional Survey

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Background: Coronavirus disease 2019 (COVID-19) is an outbreak that caused serious threats to people worldwide. Police officers are one of those frontline fighters during pandemic. Our study is the first to examine psychological health response among police officers in Ethiopia during the COVID-19 outbreak.

Methods: A cross-sectional study design with a self-administered questionnaire was conducted among police officers from Dessie town from June 20 to July 10, 2020. A total of 385 questionnaires were completed correctly accounting for 91% of the total. The data were collected by using demographic information and psychological health assessment tools. The Patient Health Questionnaire (PHQ-9), Generalized Anxiety Disorder 7-item scale (GAD-7), Insomnia Severity Index (ISI), and Brief Resilient Coping Scale questionnaire were used to assess depression, anxiety, sleep, and coping status of participants.

Results: The rate of depression was found to be 28.9%. Of these, 19.7% had mild, 7.3% had moderate, 1.6 had moderate-severe, and 0.3% had severe depression symptoms. The rate of general anxiety symptoms was found to be 30.2%. Of these, 22.1% of the police officers had mild, 2.6% had moderate, and 5.5% had severe anxiety. Moreover, 13.8% of police officers had subthreshold insomnia and 2.1% had clinical (moderate-severe) insomnia. Participants who are men, married, highly resilient, and have high social support were associated with lower depression, anxiety, and insomnia scores than those of women, being single or widowed/divorced, low resilient coping score, and low social support, respectively.

Conclusion: A psychological health problem was found to be higher among police officers in Dessie town. Younger age, sex, marital status, having chronic diseases, coping, and social support with depression, general anxiety, and insomnia were found to be significantly associated with psychological health problems. There is a need for mental health services, support, and care of police officers during the pandemic.

Keywords: COVID-19, depression, general anxiety, sleep quality, coping status

BACKGROUND

Coronavirus disease 2019 (COVID-19) is an outbreak; even if it started in China, now it is a threat illness worldwide, including Ethiopia (Malik et al., 2020). Onset of sign and symptoms may be started within 2 days or as long as 2 weeks after being infected. Fever, cough, difficulty in breathing, and shortness of breath are the most common symptoms that are reported by patients (Ganyani et al., 2020; Huang et al., 2020).

A virus causing COVID-19 is named as severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) (Lai et al., 2020). Respiratory droplets were thought to be the main mechanism of transmission from person to person among close contacts. These droplets are produced when an infected person coughs, sneezes, or talks and can land in the mouth or nose, or may be inhaled into the lungs, of people who are nearby (Shereen et al., 2020).

The COVID-19 virus has spread across the global exploding into a world pandemic for several reasons: it is transmitted by asymptomatic patients, it is highly contagious, and a few infected individuals do not experience any symptoms (Cucinotta and Vanelli, 2020).

At present, increased global mobility has provoked new outbreaks. The increasing number of patients and suspected cases has caused the general public to become infected. Additionally to healthcare workers, law enforcement officials are bravely fighting on the front lines of the pandemic (Stogner et al., 2020).

Policing is one in every of the foremost mentally challenging occupations, coping with long and infrequently rotating shifts, threats of violence, increased need for hypervigilance, and an absence of public support creating chronic stress (Carlier et al., 1997; McCraty and Atkinson, 2012).

Police services or military units charged with civil policing need to enforce and monitor these restrictions. These frontline fighters not only face an identical risk of infection because of the general public but also suffer from fatigue caused by overtime working and as well as the pressure of responsibility (Cai et al., 2020; Sun et al., 2020). In case of developing countries such as Ethiopia, these frontline fighters work without sufficient self-protective equipment and low access to healthcare services if infected, which increases the burden significantly compared to the developed countries. It results in a large number of psychological problems, such as anxiety, depression, and sleep problems, among police officers (Du et al., 2020; Stogner et al., 2020).

The aim of this study was to determine the prevalence and severity of psychological health problems among law enforcement officials during the COVID-19 pandemic, and thus it will give basis for implementing relevant psychological state intervention measures to cope with the challenge effectively. A self-administered questionnaire was used to investigate anxiety, depression, sleep status, and coping among law enforcement officials including criminal police, security police, special police, traffic police, the police of logistics support, and prison guards in Dessie town, who were in duty at the time of information collection.

MATERIALS AND METHODS

This study utilized a cross-sectional survey design to examine the prevalence and factors associated with anxiety, depression, and sleep problems in frontline law enforcement officials.

Study Setting

Data were collected from June 20 to July 10, 2020 in Dessie town during the COVID-19 pandemic. Consent was provided by the subjects before study commencement. Subsequently, we distributed self-report questionnaires to the police officers who were in duty.

Sampling Procedures

Convenience sampling method was used because we cannot find the precise number of police officers in Dessie town, and that we tried to incorporate from all style of cops (criminal police, security police, special police, traffic police, police of logistics support, and prison guards) who were on duty at the time of information collection. In addition to ethical approval obtained from Institutional Review Board (IRB) of Wollo University and permission obtained from administrative bodies in Dessie town police organization, written informed consent was obtained from each participant. The right of respondents not to give information about their privacy was reassured and any information obtained were kept confidentially. During data collection, the purpose of the study was properly clarified to the respondents and the questions were delivered in their own language. Those who scored severe psychological problems (e.g., depression, anxiety, and insomnia) were advised to contact the mental health specialist (principal investigator).

Sample Size Determination

Single population proportion formula was used to determine the sample size by considering that 95% of confidence interval, proportion of 50, and marginal error (d) of 5% were accustomed to maximize sample size. Also, 10% was used for non-response rate, and the ultimate sample size was $384 + 39 = 423$.

Study Participants

As a study participant, we included all police officers aged above 18 years, whether or not they were criminal police, security police, special police, traffic police, police of logistics support, and prison guards, who were on duty at the time of knowledge collection in Dessie town.

Materials

Questionnaires were developed to assess the demographic characteristics such as gender, age, legal status, level of education, hospital department, and city.

To screen depression, we used the Patient Health Questionnaire (PHQ-9). It is a 9-point item questionnaire that is scored from 0 to 3 generating a complete score starting from 0 to 27. A complete score of 0–4 indicates minimal depression, 5–9 mild depression, 10–14 moderate depression, and 15–19 moderately severe depression, and 20–27 severe

depression. The specificity (67%) and sensitivity (86%) of the questionnaire was validated in Ethiopia with Amharic version with Cronbach's alpha of 0.85 (Gelaye et al., 2013).

To assess the general anxiety, generalized anxiety disorder-7 (GAD-7) was used and it is a 7-point item questionnaire and every item incorporates a 4-point Likert scale that ranges from 0 to 3, where a complete score ranges from 0 to 21. The intervals 5–9, 10–14, and 15–21 represent cut points for mild, moderate, and severe anxiety, respectively. It is designed primarily as a screening and severity measure for GAD, and it is also a good tool for screening with cut point score of 10 or greater (Spitzer et al., 2006).

Insomnia Severity Index

It is a 7-item questionnaire with a 5-point Likert scale ranging from 0 to 4 where for items 1–3, 0 means “none” and 4 means “very severe,” for item 4, 0 means “satisfied” and 4 means “very dissatisfied,” for item 5, 0 means “not in any respect noticeable” and 4 means “very much noticeable,” for item 6, 0 means “not in any respect worried” and 4 means “very much worried,” and for item 7, 0 means “not the least bit interfering” and 4 means “very much interfering”. However, the severity of insomnia cannot be measured. A complete score ranges from 0 to 28. Variants 0–7 = no clinically significant insomnia; 8–14 = subthreshold insomnia; 15–21 = clinical insomnia (moderate severity); and 22–28 = clinical insomnia (severe) (Manzar et al., 2020).

Brief Resilient Coping Scale

A 4-item questionnaire with a 5-point Likert scale ranges from 1 to 5, where 1 means “not describe me at all” and 5 means “describes me very well” and its accustomed screen coping mechanisms. Various 4–13 points are low resilient copers, 14–16 points = medium resilient copers, and 17–20 points = high resilient copers (Ahern et al., 2006).

Oslo Social Support Scale

Oslo Social Support Scale (Oslo-3) went to screen the provision of social support. It is a 3-item questionnaire that ranges from scores 3 to 8 = poor support, 9 to 11 = moderate support, and 12 to 14 = strong support (Kocalevent et al., 2018).

Statistical Data Analyses

Continuous and categorical variables were summarized as mean values $\pm$ variance (SD) and frequency (percentage), respectively. Assumptions were checked first and then univariate and multivariate regressions toward the mean analysis model was fitted to spot the connection between sociodemographic factors and dependent variables (i.e., depression, anxiety, and sleep problems). Statistically significant differences were identified as a two-sided p -value < 0.05 .

RESULTS

Study Participants Demographic Data

Data from a complete set of 385 eligible participants were included within the end for a participation rate of 91% (423 of 385 participants). Of the entire sample, 385 participants (84.2%)

were men, and therefore the mean (SD) age was 34 (7.42) years; during this study, all law enforcement officials reported as they or their members of the family did not have any history of being quarantined or being infected with COVID-19. Of the full number of respondents, 197 (51.2) live alone, 156 (40.5) support members of the family, and 32 (8.3) board apartments. The bulk of law enforcement officials are single, 266 (69.1%) and 14 (3.6%) are widowed/divorced. From all the participants, 19 (4.94%) have a history of chronic medical illness, either hypertension, diabetic mellitus, cardiac illness, or asthmatic illness (Table 1).

Prevalence of Symptoms of Depression, Anxiety, and Sleep Quality

For reliability of scales, we found alpha value = 79.7, 83.2, and 91.4% for PHQ-9, GAD-7, and Insomnia Severity Index (ISI) which shows very good and above level in our study participants.

The prevalence of symptoms for psychological problems among the full sample was 28.9% (95% CI, 26.5–30.2%) have depression, with 19.7% mild depression, 7.3% moderate depression, 1.6% moderate–severe depression, and 0.3% severe depression. 30.2% (95% CI, 28.2–33.0%) have anxiety with 22.1% mild anxiety, 2.6% moderate anxiety, and 5.5% severe anxiety. 15.9% (95% CI, 13.5–17.2%) for insomnia. The majority of participants have good knowledge of COVID-19 transmission and pandemic (Table 1).

Factors Associated With Symptoms of Depression, Anxiety, and Sleep Quality

In the multivariable analysis, being younger age, sex, marital status, having chronic diseases, coping, and social support were still found to be associated with the symptoms of depression, anxiety, and insomnia. Male participants and coping score people displayed a remarkably higher risk for depression, anxiety, and marital status for insomnia (Table 2).

Male individuals showed 0.312, 0.865, and 0.035 times reduction in depressive, anxiety, and insomnia symptoms, respectively, when compared with those female participants (B , -0.312, p -value = 0.001) for depression, (B , 0.865, p -value = 0.004) for anxiety, and (B , 0.035, p -value = 0.05) for insomnia. Age of the participants was also a significant predictor of depression and insomnia symptoms with (B , 0.132, p -value = 0.002) and (B , 0.135, p -value = 0.001), respectively. In addition, associations were identified between marital status and three psychological health problems, namely, depression, anxiety, and insomnia. Being divorced/widowed increases depression symptoms (B , 1.256, p -value = 0.002), and being single decreases anxiety symptoms (B , 0.213, p -value = 0.008) but increases insomnia symptoms (B , 0.892, p -value = 0.001).

Having one or more chronic medical illnesses, from hypertension, diabetic mellitus, and cardiac illness, to asthma increases all the three psychological health problems (B , 1.235, p -value = 0.001 for depression, B , 0.825, p -value = 0.004 for anxiety, and B , 0.321, p -value = 0.002 for insomnia).

However, social support and resilient coping score reduced the score of psychological health problems, namely, depression, anxiety, and insomnia as shown in Table 3.

TABLE 1 | Socio-demographic data participants and binary linear regression analysis of depression, anxiety, and sleep problem.

Socio-demographic variables			Binary regression					
variables	Variable category	N (%) or μ (SD)	Depression		Anxiety		Sleep	
			B	Sig.	B	Sig.	B	Sig.
Age		34 (7.42)	0.154	0.003	0.015	0.630	0.095	0.001
sex	Male	324 (84.2)	-0.497	0.04	-1.965	0.002	-0.148	0.800
	Female	61 (15.8)	0		0		0	
Marital status	Married	105 (27.3)	0.424	0.353	0.262	0.004	0.1528	0.001
	Single	266 (69.1)	0.048	0.920	-0.567	0.278	1.736	0.001
	Divorced/widowed	14 (3.6)	2.314	0.039	1.613	0.195	-0.513	0.652
Religion	Orthodox	199 (51.7)	0.190	0.653	-0.603	0.195	0.079	0.853
	Muslim	149 (38.7)	-0.123	0.776	0.060	0.901	-0.400	0.361
	Protestant	21 (5.5)	0.470	0.613	3.886	0.001	2.171	0.020
Current living with	Others	16 (4.2)	-1.064	0.314	-0.893	0.444	-0.926	0.386
	Alone	197 (51.2)	-0.137	0.745	-0.380	0.415	0.662	0.144
	With family	156 (40.5)	0.182	0.672	0.786	0.097	-0.641	0.140
	In apartment	32 (8.3)	-0.124	0.821	-1.241	0.141	-0.014	0.986
	Having chronic illness	19 (4.94)	0.934	0.037	0.532	0.021	0.520	0.098
	BR Coping score	14.46 (4.23)	-0.132	0.008	-0.174	0.02	-0.093	0.066
	Social support	7.94 (3.67)	-0.109	0.008	-0.104	0.025	0.180	0.025

DISCUSSION

We found that psychological health problems among police officers in our study area were high, which shows it as a public health concern. The prevalence of symptoms for psychological

problems among the full sample was 28.9% (95% CI, 26.5–30.2%) have depression, 30.2% (95% CI, 28.2–33.0%) have anxiety, and 15.9% (95% CI, 13.5–17.2%) for insomnia.

The prevalence of psychological health problems found in the current study was similar with a prevalence study that was conducted among the overall population in China, which indicated that just about 34.4% of the respondents manifested depressive symptoms during the COVID-19 outbreak (Kang et al., 2020). Almost similar findings reported by another study done by Liang et al. (2020) in China showed that 30.43, 20.29, and 14.49% of frontline fitter doctors have health problems, such as depression, anxiety, and insomnia, during the COVID-19 pandemic.

A survey done in late January 2020 found that about one-third of respondents experienced moderate-to-severe psychological health problems which is higher than pre-outbreak prevalence report (Ahmed et al., 2020).

The results obtained *via* another online survey of Chinese adolescents revealed that the prevalence rates of health symptoms such as depression, anxiety, and a mix of depression and anxiety were 43.7, 37.4, and 31.3%, respectively (Zhou et al., 2020). In a study carried out in Singapore, the prevalence rate was reported as 22.9% (Sim et al., 2010). The difference can be due to the population and the tools they used. In China, the adolescents were included by online data collection, and in Singapore, general health questionnaires folks who came for a clinical visit were included.

A report among frontline working doctors from Bangladesh also shows slightly higher prevalence rates of anxiety, depression, and insomnia, i.e., 36.5, 38.4, and 18.6%, respectively (Barua et al., 2020). The possible reason might be the differences in population and the tools they used, e.g., Patient Health Questionnaire-4 and two-item version of the Sleep Condition Indicator.

The prevalence of symptoms of depression was beyond the previous National Health Survey in Ethiopia reported as 22.9%

TABLE 2 | Prevalence report of participants on knowledge about COVID-19, depression, general anxiety, coping status, and sleep quality.

Variable	category	frequency	Percentage
Knowledge of covid-19 transmission	By Droplet	383	99.5
	By breathing	380	98.7
	By material	385	100
COVID-19 is pandemic (worldwide disease)		385	100
History of quarantine or being infected with COVID-19/you or your family member?		0	0
Depression	Minor/no depression	274	71.2
	Mild depression	76	19.7
	Moderate depression	28	7.3
	Moderate severe	6	1.6
	Severe depression	1	0.3
Coping	Low resilient copers	124	32.2
	Medium resilient copers	117	30.4
	High resilient copers	144	37.4
General Anxiety	No anxiety	269	69.9
	Mild anxiety	85	22.1
	Moderate anxiety	10	2.6
	Severe anxiety	21	5.5
Sleep problem	No clinical insomnia	324	84.2
	Sub-threshold insomnia	53	13.8
	Clinical insomnia (moderate severe)	8	2.1
History of quarantine or being infected with COVID-19		0	0

TABLE 3 | Multivariate analyses of factors related to depression, anxiety, and insomnia.

Socio-demographic variable		Multivariate linear regression					
Variables	Variable category	Depression		General Anxiety		Sleep quality	
		B	Sig.	B	Sig.	B	Sig.
Age		0.132	0.002	0.115	0.070	0.135	0.001
Sex	Male	−0.312	0.001	−0.865	0.004	−0.035	0.05
	Female	0		0		0	
Marital status	Married	0		0		0	
	Single	0.124	0.521	−0.213	0.008	0.892	0.001
	Divorced/widowed	1.256	0.002	0.219	0.321	−0.621	0.120
Having chronic illness		1.235	0.001	0.825	0.004	0.321	0.002
BR Coping score		−0.521	0.001	−0.541	0.002	−0.393	0.021
Social support		−0.032	0.001	−0.201	0.005	0.236	0.054

(Hailemariam et al., 2012). Also, it is comparable with the psychological health problems of other frontline fitters, such as healthcare professionals, during the COVID-19 pandemic (Tsehay et al., 2020).

These study findings indicate that severe psychological health problems occur among police officers during the pandemic and due attention was not given for the importance of preventing and treating psychological health problems during the COVID-19 outbreak.

In the current study, some demographic factors influence psychological health problems during the COVID-19 pandemic. Age, female gender, having a chronic medical illness, low resilient coping score, and low social support were identified as risk factors for poor psychological health problems, such as depression, anxiety, and insomnia, as reported by previous studies. Being married is found to be a risk factor against previous literature because of the concern about being a source for infection of COVID-19 for loved ones and youngsters.

Strengths

This study examined the prevalence and factors related to psychological health problems (i.e., symptoms of depression, anxiety, and insomnia) during the COVID-19 pandemic in Ethiopia among police officers. Our findings will serve as baseline information for policymaking, recognition of high-risk populations, and framework design for psychological crisis management of police officers.

CONCLUSION AND RECOMMENDATIONS

The rates of health symptoms, such as depression, anxiety, and insomnia, were found to be higher during the COVID-19 pandemic, especially among women, advanced age, married (has family), with chronic medical illness, low coping, and low social support. Psychological health interventions are urgently needed to fulfill demand during this outbreak. The police authorities and health sectors should work on strengthening individual coping status, and the concern should be given as other frontline fitters of the pandemic.

Future studies are needed to explore the association of the COVID-19 pandemic with psychological health problems in other parts of Ethiopia and in other countries and their long-term outcomes.

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 (IRB) from Wollo University College of medicine and health science. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

MT conceptualized and wrote the manuscript. MT, MN, HG, AB, and MB have contributed to the design, data collection tool preparation, writing proposal, and editing. All authors read and accepted the final manuscript.

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The More Insufficient, the More Avoidance? Cognitive and Affective Factors that Relates to Information Behaviours in Acute Risks

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This study examines the relationship between cognitive and affective factors and people's information-seeking and -avoiding behaviours in acute risks with a 1,946-sample online survey conducted in February 2020, during the outbreak of the COVID-19 pandemic in mainland China. Multiple linear regression analysis showed that perceived information insufficiency correlates negatively with information-seeking behaviour and there was an inverted U-shaped relationship between information insufficiency and avoidance behaviour. As for the risk-related cognitive factors, information seeking increases as perceived severity of risks rises, while information avoiding increases as perceived susceptibility rises. Perceived response efficacy positively correlates with information-seeking and negatively with information-avoidance behaviours. Preliminary results also indicated that different affective factors relate to information-seeking and avoidance behaviours differently.

Keywords: information seeking, information avoidance, risk communication, health communication, public health emergency, COVID-19, China

INTRODUCTION

As of August 17, 2021, the COVID-19 pandemic has seen more than 208 million cases worldwide and over 4 million deaths (CSSE, 2020). The World Health Organisation (World Health Organization, 2020a) declared COVID-19 a Public Health Emergency of International Concern (PHEIC) in January 2020 and a pandemic in March 2020 (World Health Organization, 2020b). PHEICs are extraordinary events that are "determined to constitute a public health risk to other States through the international spread of disease and potentially require a coordinated international response" (World Health Organization, 2008, p. 9). The sudden and global impact of COVID-19 led many people to seek information. Google trends data show that "COVID-19" was the most-searched keyword worldwide in March and April 2020 (Google Trends, 2020). This indicates the importance of information availability during a public health crisis, but it foregrounds the need to ensure the proper management of a massive flow of risk-related information on the Internet and the 24-h news cycle. During the COVID-19 outbreak, people around the world are pressured to seek information about the spread of the virus and potential preventative measures at the governmental and individual level. As most people were asked to stay at home to prevent the virus's spread, most information-searching behaviours occurred online.

Previous research established various cognitive models explaining what drives information seeking behaviour. Their key hypotheses are based on cognitive processing models, including the Heuristic-Systematic Model (HSM), which has an information-oriented perspective (Chaiken, 1980), or the Extended Parallel Processing Model (EPPM) (Witte, 1994) with a risk-oriented perspective. Recent studies integrate the prediction model by incorporating cognitive processing and the affective dimension (Griffin et al., 2008; Ferrer et al., 2015). As intentional information avoidance was observed, researchers tried to enhance the model's generalizability by applying it to explain information-avoidance behaviour in risks. This research will compare how the cognitive factors and affective factors in these models correlate with the information seeking and avoidance behaviours under risks. It will also contribute to the understanding of the motives of people's information behaviours under the sudden occurrence of acute risks, which was less studied compared to the behaviours concerning chronic risks.

LITERATURE REVIEW

Risk Information Seeking and Avoidance

Risk is concerned with the uncertainty caused by an event's potentially undesirable consequences (ISO, ISO). Such uncertainty is concerned with the deficiency of information or knowledge to figure out the causes, possibilities, and consequences of the event. Barsevick and Johnson (1990, pp. 3–4) defined information-seeking behaviour as “actions used to obtain knowledge of a specific event or situation.” In communication research, information-seeking behaviour is defined as the purposive and active search for information which requires a certain level of effort and intensity (Yang et al., 2014). As such, information-seeking behaviour emphasises active and purposive behaviour, rather than passive media-scanning (Kelly et al., 2010). The sudden and novel risks brought by PHEICs are more salient in terms of their high severity of impact and low familiarity, requiring more public awareness to seek more risk-related information.

Information avoidance, described as “denial, blunting, or repression” (Lambert and Loisele, 2007, p. 1009), refers to an individual's choice to divert attention from the information. According to Maslow (1963), the word “knowing” is related to the sense of “domination, mastery, control” and the fear of knowing stems from defensive instincts. Such defensive response applies to individuals' self-recognition and their perception of the environment. While an epidemic poses an acute threat to society, prolonged risk messages may overwhelm people, especially in light of massive and contradictory information circulating via various information channels. People may hide from distressing and disappointing news reports, and feel meaningless and powerless because high degrees of uncertainty make individual efforts seem senseless. As Case et al. (2005, p. 359) stated, “Avoiding information is closely linked to feelings of anxiety and fear as well as to other cognitive and emotional variables like perceptions of treatment efficacy, self-efficacy, and locus of control...tendencies towards fatalism and avoidance can short circuit any information seeking at all.”

Previous research has investigated the factors affecting people's information seeking behaviour under risks. Based on the Risk Information Seeking and Processing (RISP) model (Griffin et al., 1999) and other information behaviour prediction models, Kahlor (2010) proposed a comprehensive theoretical model, the Planned Risk Information Seeking Model (PRISM), which aims to explain the information seeking behaviour under risks. Further, they also proposed the Planned Risk Information Avoidance (PRIA) model, that illustrate the links between cognitive as well as affective factor and information avoidance behaviour under risks. (Deline and Kahlor, 2019). For information behaviour for risks, the cognitive factors could be subdivided into information-oriented motivators and risk-oriented motivators. The information-oriented motivators comply with the basic assumption that people make economy-minded decisions on information processing strategies by maximising information sufficiency with the fewest cognitive resources (Eagly and Chaiken, 1993). Variables such as cognitive load and need for closure in the PRISM and PRIA models reveals such information sufficiency principle. The risk-oriented motivators emphasise the influence of fear induced by risks, in which people weigh the severity of the risks against their ability to cope with it. Variables such as risk perceptions and perceived behavioural control in the PRISM and PRIA models reveals such fear-control principle. Affective responses are less considered to be the predictor of information-related behaviour and but more often considered to be antecedents or consequences of the above-mentioned cognitive factors. The information-oriented motivators and risk-oriented motivators apply to different scenarios. The information sufficiency principle could account for general risk-related information-seeking behaviour, as it assumes that people satisfy their cognitive need for information and assess risk-related information rationally, with a specific goal in mind, such as having sufficient information to act. In contrast, the fear-control principle might account for information behaviour under salient threats or hazards, especially in the situation where the information sufficiency principle may overestimate human rationality and efficiency in extreme cases (Rice and Atkin, 2012). The information behaviour prediction models comprehensively explain how cognitive and attitudinal factors are related to people's information-seeking and -avoiding behaviours, while differences underlying the two principles need to be compared.

Cognitive Factors That Related to Information-Related Behaviour Perceived Information Insufficiency

Perceived information sufficiency in PRISM, similar to concept of the need for closure in the later model PRIA, refers to the amount of information or knowledge that individuals subjectively think they require to have a satisfactory judgment confidence level (Griffin et al., 2004b). Accordingly, perceived information insufficiency identifies the gaps between individuals' sufficiency thresholds and their actual knowledge (Griffin et al., 2004a) that is, it measures discrepancies between individuals' actual and desired judgmental confidence. It focuses on the

need for information and assumes people choose different information-processing strategies according to the sufficiency principle, “people will exert whatever effort is required to attain a “sufficient” degree of information to make a choice,” (Eagly and Chaiken, 1993, p. 330). When people perceive they lack actionable knowledge regarding concerns, they are more likely to process issue-related information in a systematic and effortful way. Multiple models indicate that such discrepancy motivates people to seek and process information in active and systematic ways, and therefore suggest a positive relationship between the cognitive need for information sufficiency and information-seeking behaviour (Griffin et al., 2004a; Kahlor et al., 2006; Kahlor, 2010). The information behaviour prediction models emphasise the prominent role played by people’s desire for information sufficiency. For example, the RISP model suggests perceived information insufficiency and subjective information-related norms drive people’s risk-related information-seeking behaviour (Yang et al., 2014). In that way, information-seeking behaviour is continuous and goal-oriented (Gutteling and de Vries, 2017).

Due to limited cognitive capacity, when individuals feel their need for information sufficiency has been satisfied, they allocate less time and effort to reaching out for new information. In such situations, people may avoid exposure to more relevant information and pay selective attention to new information such as obtaining it from limited sources or thinking less critically about the information they encounter (Kahlor et al., 2006). This suggests that perceived information insufficiency may positively correlate with people’s information avoidance behaviour. For risk-related information, individuals may be more likely to maintain certain degree of uncertainty because of the overload brought by the undesirable risk-related information (Yang et al., 2014). Yang and Kahlor (2013) found perceived information insufficiency were not a significant predictor of information-avoidance behaviour concerning the chronic risk, the climate change issue. They suggested that, at least in some contexts, the driving force to seeking or avoiding information may be for reasons other than information sufficiency. We therefore propose that the principle of information sufficiency still plays a role in motivating people’s information seeking in acute risks when their information needs about the novel threats are urgent. At the same time, as their confidence in the information sufficiency increases, individuals are more inclined to avoid the undesirable information related to the risks.

Perceived Risk

Risk perception originates from the protection motivation theory (Rogers, 1975). It posits that threat-related messages stimulate people’s motivation to protect themselves through two channels: threat appraisal (gauging the severity of a situation) and coping appraisal (assessing the capability of one’s response to the situation). They focus on people’s cognitive processing messages relative to risks and examines how they react to their perceptions. This approach views information-seeking and -avoidance behaviour as a response to fear aroused by perceived threats.

Witte (1994) further illustrates such cognitive process in the Extended Parallel Model which sees both the success and failure of the fear appeal as possible behavioural mechanisms. The model proposes that people will adopt different information-processing strategies depending on their cognitive appraisals of messages; specifically, how they balance their risk perception and efficacy beliefs (Miles et al., 2008). Risk perception is the “appraisal of threats” and efficacy beliefs are the “appraisal of the efficacy of the recommended response” (Witte et al., 2001, p. 24). First, threat appraisal determines whether fear is aroused when an individual evaluates the seriousness of a threat and its potential impact. Second, the aroused fears encourage individuals to respond to or control their fear, according to their efficacy beliefs. The model assumes people’s actions are either “proactive, offensive, and engaged for danger control,” or “defensive, protective, and avoidance-driven for fear control” (Miles et al., 2008, p. 1873). As for the risk perception, people assess both the extent to which an existing risk is seen to be serious and about how vulnerable they are to the existing threat (Witte, 1994), which is called perceived severity and perceived susceptibility (Sheeran et al., 2014). Previous studies indicate higher levels of perceived severity and susceptibility motivate people to take protective actions—for example, by seeking updates about emergencies and following instructions from authorities (Sheeran et al., 2014; McCaughy et al., 2018).

Studies of risk-related information behaviour demonstrate a positive relationship between individuals’ risk perception and information-seeking behaviour (Gutteling and de Vries, 2017; Deline and Kahlor, 2019). Whereas multiple studies indicated that risk perception increases information-seeking behaviours, the relationship between risk perception and information avoidance appears more complex. Some found risk perception positively predicts information-seeking and -avoidance behaviours (Witte et al., 1996; Taber et al., 2015). Others found risk perception positively predicts information-seeking but negatively predicts information avoidance (Yang and Kahlor, 2013). The lack of consensus suggests individuals’ risk perceptions may influence information-related behaviour, especially information-avoidance behaviour, in a complex way. To investigate the reasons for differential effects on information-seeking and -avoidance behaviours during an acute risk, this research will separately examine both aspects of risk perception: perceived severity and perceived susceptibility.

Perceived Efficacy

Perceived efficacy is an individual’s evaluation of effectiveness, feasibility, and convenience in the face of a threat (Sweeny et al., 2014). Based on their appraisal of the efficacy, they often chose either protective or defensive strategies to cope with severe threats. Previous research indicates that perceived risk and efficacy positively predict risk information-seeking behaviour (Kievik and Gutteling, 2011). However, in situations where the threat exceeds people’s perceived efficacy, people may choose not to control the threat. Instead, they defensively control their emotions, like fear, with avoidance-based strategies such as denying the need to act and the existence of danger (Li, 2018).

In this study, we may characterise peoples' inattentiveness to vital information during a crisis as defensive, avoidant behaviour (Miles et al., 2008). Perceived efficacy for risks includes both self-efficacy and response efficacy. Self-efficacy is a person's perception of his/her ability to implement the recommended response suggested by governors, professionals or to reduce the threat. Furthermore, response efficacy refers to a person's belief in the effectiveness of the recommended response in stopping the threat (Witte, 1998). To investigate how perceived efficacy for risk correlates with information behaviours differently, the effects of efficacy for self and response on information behaviours were examined separately.

Affective Factors That Relates to Information-Related Behaviour

Gutteling and de Vries (2017) assert affective responses to perceived risks make people more aware of their personal relevance to threats. However, the empirical evidence on how affective factors are related to information-related behaviour is inconsistent and fragmented. Most studies focus on one or two affective factors, such as anger or feeling worried (Griffin et al., 1999, 2008; Yang et al., 2014) or sadness and happiness (Tiedens and Linton, 2001). Scholars proposed that risk perception is directly related to the native valence of affects, as threats are likely to produce negative emotions (Griffin et al., 1999); however, perceived threats can produce positive affective responses as well (Griffin et al., 2008). Empirical evidence suggests that inconclusive evaluations of threats can promote systematic information-processing (Tiedens and Linton, 2001), and possibly motivate proactive information seeking.

These researches have indicated that both negative and positive emotions can stimulate information-seeking behaviour, especially in high-risk contexts. Therefore, the relationship between risk perception and information-related behaviour may be context-specific and dependent on individual preferences. Based on the positive and negative valence of affect, Yang examined affective responses to risk by measuring several specific affective factors (Yang, 2012; Yang and Kahlor, 2013). They found peoples' negative emotions regarding climate change stimulate information-seeking behaviour, and peoples' optimism about the same issue led to information-avoidance behaviour. This result needs to be interpreted in the context of chronic risks, where people may not perceive a strong sense of urgency or prioritise acting immediately. However, whether the finding could be applied to acute risk situations should be examined and discussed, as high levels of urgency and threat under such situations may cause avoidance from the discomfort of negative feelings. To investigate how different affective responses correlates with information-seeking and -avoidance behaviour, six affective responses about the issue of the COVID-19 pandemic were examined.

We developed the following five hypotheses regarding how cognitive factors are related to information-seeking or -avoidance behaviour under acute risks. We also identified a research question to explore how affective responses to risks correlates with information behaviour under acute risks (see in **Figure 1**).

Hypothesis 1: Individuals' perceived level of perceived information insufficiency towards COVID-19 will be: a) positively related to information-seeking behaviour, and b) negatively related to information-avoidance behaviour.

Hypothesis 2: Individuals' perceptions of the severity of COVID-19 will be positively related to a) information-seeking, and b) information-avoidance behaviour.

Hypothesis 3: Individuals' perception of their susceptibility for COVID-19 will be positively related to a) information-seeking, and b) information-avoidance behaviour.

Hypothesis 4: Individuals' perceived self-efficacy regarding COVID-19 prevention will be: a) positively related to information-seeking behaviour, and b) negatively related to information-avoidance behaviour.

Hypothesis 5: Individuals' perceptions of their response efficacy towards COVID-19 prevention will be: (a) positively related to information-seeking behaviour, and (b) negatively related to information-avoidance behaviour.

Research Question: How are peoples' different affective responses related to information-seeking and information-avoidance behaviour?

METHODS

Data Collection

Data were collected through a survey of Chinese residents between February 25 and 28, 2020. We employed a quota sampling method based on China's population distribution by province. The survey's URL link or QR code was sent to prospective respondents through social networking platforms. This study was reviewed and approved by School of Journalism and Communication, Nanjing University. A cover page told participants that they would take part in a research about health-related behaviour. All provided informed consent before enrolling and completing the survey. The population comprised Chinese residents aged 18 years and above who had Internet access. Because of budget and resource constraints, the target sample size was 2,000 people; after excluding invalid responses, the final valid sample size was 1,946 people. Among the respondents, 63% were male and 37% were female compared to 51.2 vs. 48.8% in the population. Of these, 90.4% were 18–40 years old, and 68.6% holds a bachelor's degree or higher (compared to 15.5% in population). For other variables using multiple-item scales, we used their mean value of all items as the score.

Measures

Perceived Information Insufficiency

Perceived information insufficiency gauges the gap that exists between the perceived current knowledge and the information sufficiency threshold (Griffin et al., 2004a).

They measured participants' perceptions of their current knowledge and sufficiency threshold on a scale ranging from 0 to 100. In this research, participants were asked to rate their current knowledge of COVID-19 and the amount of information they felt would be sufficient for them to appropriately confront the pandemic. We subtracted the former score from the latter to

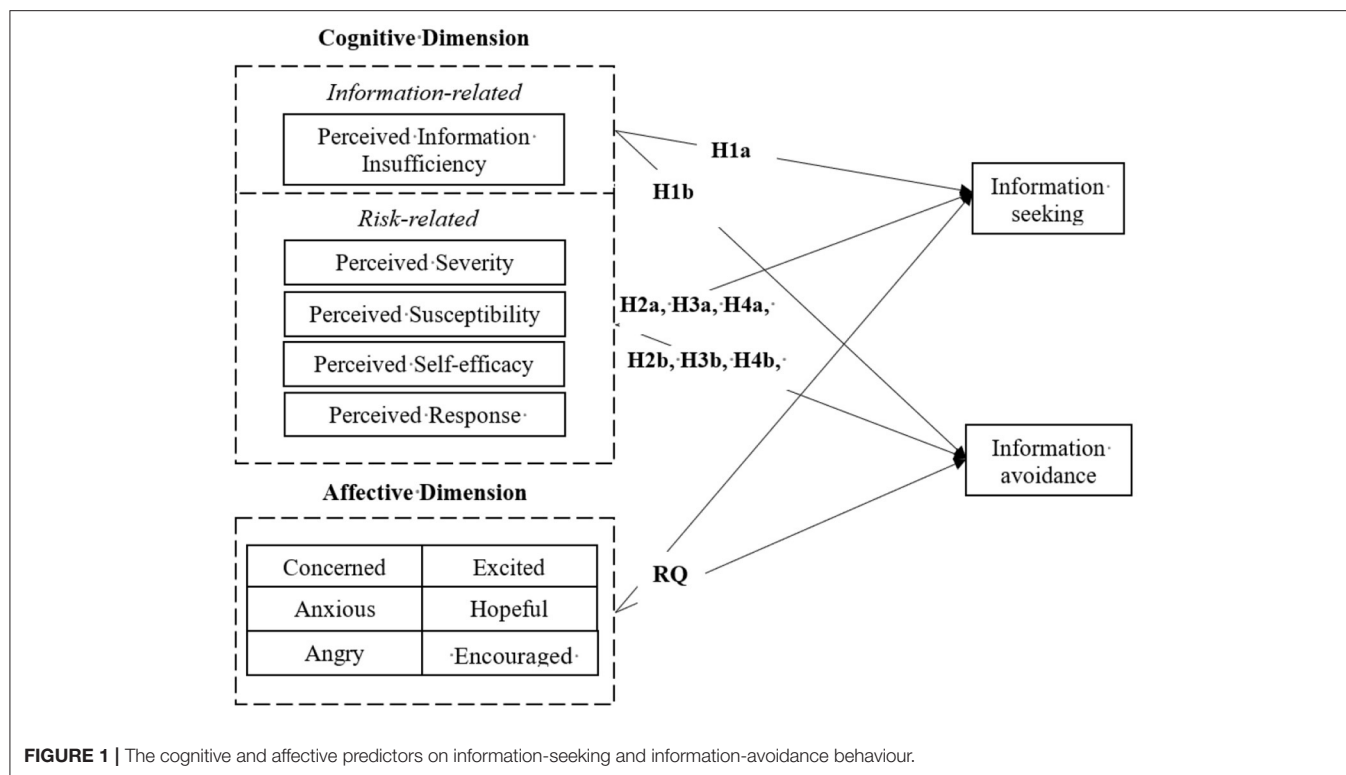


FIGURE 1 | The cognitive and affective predictors on information-seeking and information-avoidance behaviour.

measure participants' perceived information insufficiency (mean = -5.91 , standard deviation or $SD = 29.63$).

Perceived Severity and Perceived Susceptibility

Following the Risk Behaviour Diagnosis Scale of Witte and colleagues, we measured participants' perception of threats on a six-item scale (Witte et al., 1996). It measured perceived severity and perceived susceptibility using three items for each. We modified the general threat-related statements to ask specific questions about participants' COVID-19 threat perception. They were asked to indicate their level of agreement with the survey's statements on a seven-point Likert scale, where 1 = "completely disagree" and 7 = "completely agree." The statement measuring perceived severity was, "I believe that the pandemic is severe/serious/significant" (mean = 5.06 , $SD = 1.47$, Cronbach's $\alpha = 0.88$); and the statement measuring perceived susceptibility was, "I am at the risk of / It is likely that I will contract / It is possible that I will contract COVID-19" (mean = 3.21 , $SD = 1.60$, Cronbach's $\alpha = 0.87$).

Perceived Self-Efficacy and Perceived Response Efficacy

We measured perceived efficacy by a scale established by Witte and colleagues—i.e., a two-dimensional, six-item scale using the same response scale of perceived threats, where the two dimensions were self-efficacy and response efficacy (Witte et al., 1996). In this study, the recommended response was washing one's hands and wearing a face mask in public. Statements used to measure response efficacy were, "The recommended response works to prevent COVID-19 disease," "The recommended

response effectively prevents COVID-19 disease," and "If I respond in the recommended way, I am less likely to get COVID-19 disease" (mean = 5.71 , $SD = 1.24$, Cronbach's $\alpha = 0.88$). Statements used to measure self-efficacy were, "I am able to respond in the recommended way in order to prevent myself from getting COVID-19 disease," "The recommended response is easy to do," and "The recommended response is convenient" (mean = 5.72 , $SD = 1.23$, Cronbach's $\alpha = 0.87$).

Affective Response

Following Yang and Kahlor, we measured participants' affective responses to the pandemic through six items composed of both positive and negative aspects (Yang and Kahlor, 2013). For positive affective factors, respondents were asked the extent to which they felt concerned (mean = 4.24 , $SD = 1.40$), anxious (mean = 3.82 , $SD = 1.46$), angry (mean = 3.42 , $SD = 1.58$), excited (mean = 3.03 , $SD = 1.66$), hopeful (mean = 4.78 , $SD = 1.26$), and encouraged (mean = 4.11 , $SD = 1.52$) about the pandemic, and their responses were registered on a six-point scale ranging from "not at all" (1) to "very" (6).

Information-Seeking

The five-item information-seeking scale developed by Griffin et al. (2004b) contains a reversed item that may confuse the respondents with information-avoidance behaviour. Therefore, we removed the reverse-coded item and asked participants to report their frequency of the following behaviours in the past month through a four-item, five-point frequency scale (from 1 = "never" to 5 = "always"). The four items were, "I actively search for pandemic-related information," "I actively follow the latest

TABLE 1 | Descriptive analysis of all variables.

Variables	N (%)	Min	Max	Mean	SD	Cronbach's α
Age						
18–40	1760 (90.4)					
41–60	182 (9.4)					
>60	4 (0.2)					
Level of Education						
Primary	21 (1.1)					
Junior High School	119 (6.1)					
Senior High School	471 (24.2)					
College	518 (26.6)					
Bachelor	749 (38.5)					
Master or above	68(3.5)					
Gender						
Male	1226 (63)					
Female	720 (37)					
Information seeking		1	5	3.59	0.9	0.91
Information avoidance		1	5	2.31	1.11	0.94
Information sufficiency		–100	100	–5.91	29.63	
Perceived severity		1	7	5.06	1.47	0.88
Perceived susceptibility		1	7	3.21	1.6	0.87
Self-efficacy		1	7	5.71	1.24	0.88
Response efficacy		1	7	5.72	1.23	0.87
Concerned		1	6	4.24	1.40	
Anxious		1	6	3.82	1.46	
Angry		1	6	3.42	1.58	
Excited		1	6	3.03	1.66	
Hopeful		1	6	4.78	1.26	
Encouraged		1	6	4.11	1.52	

pandemic information,” “I am likely to go out of my way to get more information about the pandemic,” and “I try to learn more information about the pandemic through various channels.” The reliability of this four-item scale was relatively high (mean = 3.59, $SD = 0.90$, Cronbach's $\alpha = 0.91$).

Information-Avoidance

To measure information-avoidance behaviour, we adopted the scale developed by Yang and Kahlor (2013). The climate change topics of the original scale were adapted to pandemic-related ones. Participants responded to the following five items through a five-point scale (from 1 = “never” to 5 = “always”): “I avoid information about the pandemic,” “When it comes to the pandemic, I don't want to know more,” “I refuse to listen to information about the pandemic,” “I tune out information about the pandemic,” and “I ignore information about the pandemic” (mean = 2.31, $SD = 1.11$, Cronbach's $\alpha = 0.94$).

Control Variables

Demographic variables were measured as control variables. Gender was coded as dummy variable (0 for female, 1 for male). Age was measure in three brackets (18–40, 41–60, beyond 60). Educational background was measured by asking the highest

level of education (Primary, Junior high school, Senior High School, College, Bachelor, Master or above).

RESULTS

The descriptive analysis of all variables is shown in **Table 1**.

The correlation matrix of the all variables is presented in **Table 2**.

To test the hypotheses, two hierarchical multiple regression models were built with information seeking and information avoidance as outcome variables separately (see **Table 3**). We entered demographic variables (age, gender, and education level) in the first block. Cognitive factors such as participants' perceptions of their perceived information insufficiency, risk severity, susceptibility, self-efficacy, and response efficacy were entered in the second block. The cognitive dimension factors of the second model accounted for 20% of the variance ($\Delta R^2 = 0.19$, $p < 0.01$) in information-seeking behaviour, and 21% of the variance in information-avoidance behaviour ($\Delta R^2 = 0.25$, $p < 0.01$). Then we entered the six affective dimension variables into the third block. The explanatory power of the third model became 21% in the regression model of information seeking ($R^2 = 0.21$, $p < 0.01$), and 29% in the

TABLE 2 | Zero-order correlation matrix of all variables.

	Information avoidance	Perceived information insufficiency	Perceived severity	Perceived susceptibility	Self efficacy	Response efficacy	Concerned	Anxious	Angry	Excited	Hopeful	Encouraged
Information seeking												
Information avoidance	-0.097**	-0.141**	0.323**	-0.046*	0.394**	0.393**	0.135**	0.074**	0.005	-0.059**	0.212**	0.149**
Perceived information insufficiency		0.176**	-0.118**	0.320**	-0.388**	-0.434**	0.031	0.146**	0.282**	0.325**	-0.111**	0.076**
Perceived severity			-0.083**	0.090**	-0.182**	-0.174**	-0.044	0.017	0.062**	0.109**	-0.076**	0.007
Perceived susceptibility				0.090**	0.389**	0.402**	0.206**	0.150**	0.038	-0.099**	0.171**	0.083**
Self efficacy					-0.323**	-0.310**	0.143**	0.229**	0.244**	0.261**	-0.117**	0.035
Response efficacy						0.868**	0.035	-0.090**	-0.199**	-0.257**	0.311**	0.103**
Concerned							0.043	-0.087**	-0.218**	-0.285**	0.319**	0.089**
Anxious								0.619**	0.415**	0.014	0.067**	0.046*
Angry									0.521**	0.166**	0.023	0.099**
Excited										0.299**	-0.041	0.115**
Hopeful											0.095**	0.369**
												0.431**

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

regression model of information avoidance ($R^2 = 0.29$, $p < 0.01$).

Both hypotheses 1a and 1b were not supported, as the results demonstrated opposite findings. Contrary to hypothesis 1a, participants' perceived information insufficiency was negatively related to their information-seeking behaviour ($\beta = -0.09$, $p < 0.01$). Hypothesis 1b was not supported, since the relationship between perceived information insufficiency and information-avoidance behaviour ($\beta = 0.05$, $p > 0.05$). Moreover, a quadratic regression analysis was performed to quantify the relationship between information insufficiency and their corresponding information seeking and avoidance behaviour. The results showed that the squared term of information insufficiency is not significantly related to information seeking behaviour ($\beta = -0.04$, $p > 0.05$) and was negatively related to information avoidance behaviour ($\beta = -0.05$, $p < 0.05$). The regression equation was found to be: estimated information avoidance = $2.412 + 0.003(\text{information insufficiency}) - 0.00009(\text{information insufficiency}^2)$. There indicates inverted "U-shape" relationship between information insufficiency and information avoidance behaviour.

Hypothesis 2a was supported, as participants' perceived risk severity positively predicted their information-seeking behaviour ($\beta = 0.15$, $p < 0.001$). Despite the positive effect of perceived severity on information-seeking, its effects on information avoidance behaviour were found to be insignificant ($\beta = 0.01$, $p > 0.05$), and thus hypothesis 2b was not supported.

Hypothesis 3a was not supported, while hypothesis 3b was supported; the effect of participants' perceived susceptibility turned out to be insignificant ($\beta = 0.04$, $p > 0.05$) after the affective factor variables were entered into the regression model. By contrast, the regression results showed that perceived susceptibility positively predicted information avoidance ($\beta = 0.14$, $p < 0.001$). Results for hypotheses 2 and 3 showed that two aspects of risk perception exerted a differentiated effect on information-seeking and -avoidance behaviour during COVID-19. Perceived severity only positively predicted information seeking ($\beta = 0.15$, $p < 0.001$), and perceived susceptibility positively predicted information avoidance ($\beta = 0.14$, $p < 0.001$).

Hypothesis 4a was supported since participants' perceived self-efficacy positively predicted information-seeking behaviour ($\beta = 0.18$, $p < 0.001$). However, hypothesis 4b was not supported, as the relationship between self-efficacy and information-avoidance behaviour was insignificant ($\beta = 0.01$, $p > 0.05$).

Both hypotheses 5a and 5b were supported, as participants' response efficacy had a positive effect on information-seeking behaviour ($\beta = 0.17$, $p < 0.05$) and a negative effect on information-avoidance behaviour ($\beta = -0.30$, $p < 0.001$).

Finally, we tested the research question about the effects of affective factors by entering the six affect-related variables into the third step of the hierarchical multiple linear regression model. The final model explained 22% of the variance in information-seeking behaviour and 29% of the variance in information-avoidance behaviour. Among the six affective factors, feeling concerned ($\beta = 0.06$, $p < 0.05$) and encouraged ($\beta = 0.08$, $p < 0.01$) were positively and significantly related to information-seeking behaviour. Other affective responses did not display a

TABLE 3 | Hierarchical multiple regression effects on information-seeking and information-avoidance behaviour.

	Information-seeking			Information-avoiding		
	Block 1	Block 2	Block 3	Block 1	Block 2	Block 3
Gender	0.06**	0.02	0.02	−0.19***	−0.13***	−0.11***
Age	0.07**	0.04*	0.04	−0.01	−0.01	−0.04
Education	0.07**	0.00	0.01	−0.08**	−0.03	−0.02
Information insufficiency		−0.10***	−0.09***		0.04	0.05
Information insufficiency ²		−0.05	−0.04		−0.08**	−0.05*
Perceived severity		0.17***	0.15***		0.02	0.01
Perceived susceptibility		0.06*	0.04		0.19***	0.14***
Self-efficacy		0.19***	0.18***		0.01	0.01
Response efficacy		0.17***	0.17***		−0.35***	−0.30***
Concerned			0.06*			−0.04
Anxious			0.02			0.02
Angry			0.02			0.14***
Excited			0.00			0.13***
Hopeful			0.04			−0.01
Encouraged			0.08**			0.03
Adjusted R²	0.01***	0.2***	0.22***	0.04***	0.25***	0.29***
R² Change		0.19***	0.02***		0.21***	0.04***

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

significant effect on information-seeking behaviour. Also, being angry ($\beta = 0.14$, $p < 0.001$) or excited about the pandemic ($\beta = 0.13$, $p < 0.001$) were positively related to participants' information-avoidance behaviour.

Table 2 displays the regression effects.

DISCUSSION

This paper examined the relationship between various cognitive factors and individuals' information-seeking and information-avoidance behaviours under the acute health risk of the COVID-19 pandemic. The results suggest that people's information behaviour under acute risks did not follow the sufficiency principle. Instead, perceived information insufficiency encourages information avoidance behaviour and discourages information-seeking behaviour. The findings provided support for the fear-control principle that predicts risk information behaviours, while it also demonstrated how the cognitive factors concerning fear-appraisal and response-appraisal stimulate information-seeking and information-avoidance behaviours in different ways.

Cognitive Dimension

Perceived information insufficiency negatively correlates to information-seeking behaviour. In the COVID-19 context, the gap between peoples' actual and desired knowledge dulled their desire to actively seek pandemic-related information-seeking. There was an inverted U-shaped relationship between information insufficiency and avoidance behaviour. When the level of information insufficiency is relatively low, people deliberately avoid relevant information. When the gap of information inadequacy widens, they shift to a reduced tendency

to avoid. These results were contrary to the Heuristic Systematic Model and its sufficiency principle proposed by Eagly and Chaiken (1993). We might explain this result by arguing that the information sufficiency principle, reliant on cost-benefit analysis and does not take into account the fact that more information does not always help people make informed decisions, especially in the Internet age. Indeed, more knowledge may cause cognitive dissonance (Festinger, 1962) or fear (Witte, 1994), especially among people with low judgmental confidence. Goodall and Reed (2013, p. 69) found people would rather maintain their uncertainty towards bed bug risk in their homes rather than know for sure that they are at risk; "individuals seek to maintain uncertainty, as it allows them to maintain their current state of information and avoid information that is likely to be distressing." This cognitive process reveals that people often possess a defensive motive for personal beliefs, one that co-exists with their desire to hold an accurate belief (Chaiken et al., 1996).

In this study, risk-related cognitive factors had varying effects on information seeking and information-avoidance behaviour. In the COVID-19 context, individuals who perceived the situation as severe were more likely to actively seek information. However, when they saw a greater likelihood of being personally affected, they tend to avoid the information regarding the risks. Such differentiation between the effect of perceived severity and perceived personal susceptibility might account for the contradictory results of previous research that examined the impact of general risk perception on information-avoidance behaviour. This finding extends the impersonal impact hypothesis (Tyler and Cook, 1984), which held "media primarily increase societal-level risk perception, but they have little impact on personal-level risk perception," (Oh et al., 2015; p. 15). El-Toukhy (2015) found individuals perceived different levels

of susceptibility for themselves and others, which indicated an optimistic bias, while such a difference was not found in the perceived severity. In our study, the perceived severity of societal-level risks stimulated information-seeking behaviour and had little effect on information avoidance. By contrast, perceived susceptibility, as personal-level risk perception, stimulated information avoidance.

The results generally supported our hypothesis regarding self-efficacy, except the relationship between self-efficacy and information-avoidance behaviour was insignificant. These results were consistent with previous findings, which showed that when individuals perceived that recommended risk-prevention measures were feasible and effective, they were more willing to actively seek relevant information.

By contrast, higher perceptions of response efficacy could reduce information-avoidance behaviour. With COVID-19, if participants were confident the recommended public health measures could prevent the spread of the disease, they were more likely to engage in information-seeking behaviour. These results were consistent with the fear-control principles; namely, that perceived risks arouse people's fear, and that perceptions of efficacy determine risk responses. In this study, low levels of perceived response efficacy triggered a fear-control response and encouraged participants to deny or neglect a threat's severity, leading to information-avoidance behaviour. However, perceptions of self-efficacy did not trigger information-avoidance responses, possibly because perceptions of low efficacy may lead to fatalism (Miles et al., 2008).

Affective Dimension

This study showed that the previous valence-based dichotomous classification of affective factors, where risk-related information had either a positive or negative effect on information behaviour, may not fully explain the information behaviour under acute-risk environments such as a global pandemic. Feeling concerned or encouraged positively relates to information-seeking behaviour, while information avoidance positively relates to feeling angry and excited. This demonstrated that the valence of affective responses cannot explain the differentiated effect that affective factors have on information behaviour. Su et al. (2021) found that the positive words (such as faith, blessing, praise, and love) on Chinese social media platform changed significantly across different stages of the pandemic. The use of positive emotive words, such as faith and blessing, indicates a concern for group cohesion and social solidarity during the outbreak of the epidemic. These results might explain why previous research findings were inconsistent. Our findings indicated that during a public health emergency, more intense and risk-heavy messages (such as angry and excited) may stimulate information-avoidance behaviour. This was contrary to a study that showed people's preference for attention to high-arousal messages (Lang et al., 1995).

This paper had several limitations. First, the results should be interpreted carefully with the consideration of the timing point of data collection, especially given the likelihood of recall and self-report bias. Due to the epidemic prevention and control

policy at the time, we only conducted our research through the online channel, which to some extent made the sample more biased towards the younger adult population. Also, due to the cross-sectional data design, all of the variables were measured simultaneously, which does not allow for establishing a causal relationship. Second, perceived information insufficiency was measured by calculating the difference between the two relevant components of insufficiency to simplify the results; other studies suggest taken different approaches (Kahlor et al., 2006; Griffin et al., 2008). Lastly, this research examined the direct impacts of the cognitive and affective antecedents of information behaviour, future research could examine how the factors interacts and goes beyond the additive model.

CONCLUSION

This paper makes several contributions to the literature on information-seeking and information-avoidance behaviours. First, it provided evidence that is contrary to the sufficiency principle predicting information behaviour in acute risks, suggesting the influence of other motives beyond the need for accuracy in acute risks. Second, differentiated effects of risk-perception-related variables on information-seeking and information avoidance should be noted. This demonstrated the necessity of further investigation into how personal- and society-level risk perceptions relates to fear-control responses leading to information-seeking or -avoidance behaviour. Third, by investigating various affective factors that information-related behaviour, this study asserted the aforementioned valence-based classification of affective factors may not clarify risk-related information behaviour. This study captures the information behaviour of individuals during acute and unknown risk outbreaks. In this case, people's behavioural rules may differ significantly from those of long-term, known, controlled risks. The COVID-19 pandemic will eventually be a thing of the past, but unknown, emergent risks are ever-present for humans.

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 School of Journalism and Communication, Nanjing University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

SZ and YL contributed to conception and design of the study and wrote the first draft of the manuscript. SZ organized the database. YL performed the statistical analysis and wrote sections of the manuscript. Both authors contributed to manuscript revision, read, and approved the submitted version.

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Stress of Overseas Long-Distance Care During COVID-19: Potential “CALM”ing Strategies

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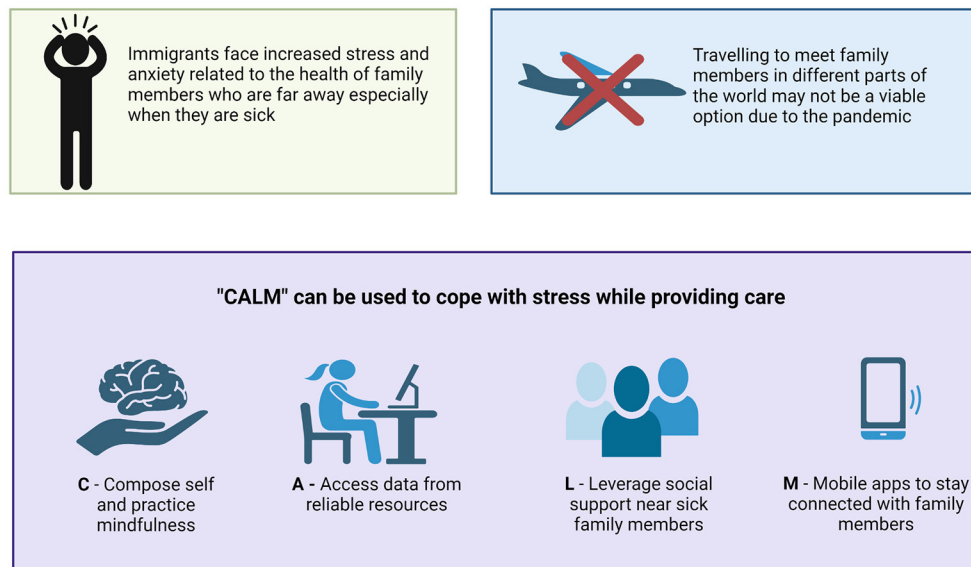
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Coronaphobia, a fear of contracting COVID-19, has been a particular problem for immigrants in the US whose families live in their native lands (1). The United States is a land of immigrants with immigrants and their US-born children number constituting ~26 percent (around 85.7 million) of the population (2). There has been an increase in stress and anxiety in association with the ongoing pandemic, and immigrants are not immune to it. Although measures have been taken to control the spread, and new vaccines are being developed and administered, fear continues to grip the entire world. With new strains creeping in, it only adds to more anxiety and uncertainties to the already existing undercurrent of tension related to COVID-19.

Immigrants are concerned for the safety of the have family members in their home country and the well-meaning worries related to health of family members have escalated during the pandemic. Their parents and most of their close family members back home are in the older adult age group which makes them more vulnerable to COVID-19 infection. Additionally, if they have medical comorbidities, then they are stratified to be in the high-risk category for COVID-19 infection. In the current setting of the pandemic, when any family member back home reports that they are sick (especially with flu-like symptoms), it creates anxiety, stress, and unrest in the immigrant who is thousands of miles away in the US. The first impulse is to think about COVID-19 infection as that is the viral infection that is the most prevalent in current times. Other factors that add to existing stress and anxiety are inability to get tested in other countries due to limited resources, or test avoidance by family members due to various reasons like misinformation, stigma or financial barriers.

The immigrants' parents and other family members cannot be in the US for various reasons, such as personal preference, visa, and travel restrictions. For immigrants, traveling to their home country is an arduous process and may not be an option currently for a multitude of reasons. It requires preparation in advance, extended time off and may need half to a full day to travel across the globe. It is expensive and may lead to loss of productivity and utilization of unpaid leaves which leads to a financial burden. The pandemic has made travel even more challenging as there is the risk of getting infected with this deadly virus. Unlike pre-COVID era when people could travel to their home countries and visit family members, travel has not remained a viable option. Even if one considers risking travel, one has to jump through hoops to reach the final destination such as adhering to different travel guidelines and policies which are variable and frequently changing, taking a longer route as there is travel ban in some countries to limit the entry of the new strain of virus. If that is tackled and somehow one is successful in reaching home, then the first few days upon arrival may be spent in quarantine (3). If COVID negative test results are not provided, little can be done to help sick family members in that period. The question arises as how to tackle this situation, which is nerve-wracking in more ways than one.

Stress of overseas long-distance care during COVID-19: Potential "CALM"ing strategies



GRAPHICAL ABSTRACT | "CALM"ing strategies during COVID-19 pandemic. Created with BioRender.com.

The surge of variants, in particular delta variant has created fresh challenges. It has shown that even fully vaccinated people are susceptible to the infection. Such breakthrough infections appear rare and mild (4) but scientific data remains limited. Even in places with relatively high vaccination coverage (5), fully vaccinated people run the risk of getting infected in large gatherings, leading to guidance that social distancing and mask-wearing continue regardless of vaccination status. Although a direct comparison is not appropriate due to different vaccines being available in different countries, at least one study (6) noted fully vaccinated individuals to be infected in similar numbers as those who are unvaccinated albeit experience a minor course of illness. Such news taken out of context, might affect the morale of the general population and their confidence in vaccines and other preventative measures.

Considering the common hurdles, emotional reaction and available remote resources we came up with an approach to allay anxiety for the immigrants while helping their loved ones actively. Immigrants can consider a few things to navigate through this situation. We have devised the following mnemonic to help immigrants who are physically separated from family members deal with this situation: CALM.

C—Compose self and act mindfully. It is common to feel terrified when a relative who is far away has a fever or is otherwise sick, due to the variability of presentation and high prevalence of COVID-19. However, it is important to realize that there could be other reasons for illness, such as common cold. Many illnesses can be promptly cured, and, not all illnesses are deadly. This knowledge may allay some concern about COVID-19 but there may be lingering anxiety which

could be reduced by mindfulness. Several studies have reported that mindfulness-based interventions are beneficial in reducing anxiety, depression, and stress levels (7–9). Apart from helping with stress, and anxiety in healthy population, mindfulness has been shown to be helpful for patients with chronic illnesses to cope well (10).

There are many mindfulness apps available like The Mindfulness App, Headspace, Calm, Serenity etc, which can come in handy. The authors recommend trying different platforms before deciding the one that works for an individual. Once they decide and pick the one, they feel is the best for them, sticking with it and practicing regularly for around 10–30 min daily will lead to optimal benefits. Many of these apps are available for iOS and Android platforms and have free tiers that can be utilized to assess their suitability. They offer a variety of meditation sessions of varying durations. The benefits of such apps might also extend to patients as well, and immigrants might find it beneficial to coordinate a time with their loved ones overseas to simultaneously try a meditation session and discuss outcomes.

A—Access data from reliable resources. The world wide web is full of data and information about COVID-19, but all information may not be accurate. Reliance on dubious news articles or shows which might be sensationalizing the situation, or on word-of-mouth personal experiences may often magnify the stress. Reviewing websites like Centers for Disease Control and Prevention (CDC) (11) and The Institute for Health Metrics and Evaluation (IHME) (12) can provide a much more reliable data. IHME has country-specific data which immigrants can use to better understand the situation in their home country. It may

be that the situation in a particular place is not as bad as the immigrant automatically assumes.

L–Leverage social network around the sick family member. Social network can be very supportive in these testing times. There is evidence that higher level of perceived social support helps in counteracting the negative impact of the pandemic on mental health and helps in building resilience which can help in quicker recovery (13). Social network can be considered within micro-context (e.g., family members), and macro-context (e.g., community-based networks) (13). In many cultures, extended families live relatively close to each other. Using their help in such a situation can prove vital. They are physically present near the index family member and can provide physical and emotional support. In some cases, friends and co-workers may also support the sick family member by helping them with food, medicines, and if needed arranging a doctor's visit, while taking the necessary precautions to protect themselves from COVID or other communicable infections. They may also be able to give a better and unbiased account of the health of the involved family members to the immigrant. Also, people in the vicinity are more aware of the local resources available e.g., hospitals providing COVID specific care, to help deal with this situation.

M–Mobile apps like Google Hangouts, Duo, Facetime, WhatsApp, and Signal, can be used to communicate with family members abroad. The texting, audio, and video services available with these apps have made communication easier and are great ways of providing family-centered care during the pandemic (14, 15). Communicating with family members who are at distant places via audio or video may give an appraisal of their general

health condition, which may help allay some anxiety. These apps are encrypted and can be used to share protected health information such as results of labs, imaging etc. with the consent of sick family members. This information can be helpful to some immigrants, especially those who are health care professionals. Reviewing such information can give a fair idea of the condition and the type of medical care being provided, which can be reassuring. If care provided is not optimal, then redirecting them to better resources may be done. Frequent communication with the sick family member also gives the family member a feeling of comfort and being cared for. This may help in strengthening the overall bond among family members.

In conclusion, the COVID-19 pandemic has brought with it many challenges and illness of close family members who are separated by distance only adds more stress and feelings of helplessness to the already overwhelming situation. Travel is risky and may not be advisable. Using CALM techniques may help immigrants and families allay some anxiety and help them deal with this trying situation.

AUTHOR CONTRIBUTIONS

AD: conceptualization, literature review, interpreting data, and manuscript preparation. KP: critical review of the manuscript and manuscript preparation. PB: literature review and critical review of the manuscript. PP: conceptualization, critical review, and manuscript preparation. All authors have contributed significantly to the paper and approval of the final version.

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The Societal Influences and Quality of Life Among Healthcare Team Members During the COVID-19 Pandemic

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Background: The coronavirus infection disease 2019 (COVID-19) pandemic is likely to put healthcare professionals across the world in an unprecedented situation.

Methods: A total of 683 healthcare workers were recruited in this study. Short form-12 items (SF-12), Societal Influences Survey Questionnaire (SISQ), and Disaster-Related Psychological Screening Test (DRPST) were used to survey participants. Multiple linear regression and structural equation model (SEM) were used to explore the possible factors to the societal influences and quality of life.

Results: After multiple linear regression analysis, female, older, more education years, married, regular intake, and posttraumatic stress disorder (PTSD) frequency had positive association with SISQ. To physical component summary (PCS) of SF-12, chronic illness, sleep score, PTSD frequency, and social distance had negative association, and exercise habits had positive association. A mental component summary (MCS) value of SF-12, age, participate in social activities, and social information had positive association, and PTSD frequency, sleep score, social anxiety, and depression had negative association. Under SEM analysis, PTSD had positive influence on SISQ. Sleep score and MCS value had negative influences on SISQ. PTSD severity, older age, sleep score, smoking, and nursing staff had negative influences on PCS value. Young age, PTSD frequency, sleep score, and depression had negative influences on MCS value.

Conclusion: Healthcare team members with severe PTSD symptoms suffered more societal influences. Relative to PTSD severity, PTSD frequency was more important to the quality of life. Members of older age who frequently participate in clubs, volunteers, or charity activities had better mental life quality.

Keywords: disaster-related psychological screening test (DRPST), societal influences survey questionnaire (SISQ), short form-12 items (SF-12), quality of life, corona virus infection disease 2019 (COVID-19), structural equation model (SEM)

BACKGROUND

The COVID-19 pandemic is likely to put healthcare professionals across the world in an unprecedented situation, having to make impossible decisions and work under extreme pressures (1). Among the healthcare workers also, they are involved directly in handling patients and are at greater risk than others. The reasons for such adverse psychological outcomes in them range from excessive workload/work hours, inadequate personal protective equipment, over-enthusiastic media news, and feeling inadequately supported (2, 3).

Another important reason for such psychological impact is the infection risk among medical staff. The sudden reversal of role from a healthcare worker to a patient might lead to frustration, helplessness, adjustment issues, stigma, and fear of discrimination in the medical staff (4). Despite the low mortality rate of 2%, the COVID-19 virus has a high transmission rate and the number of deaths is higher than that caused by severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS) combined (5). The psychological impact of COVID-19 and other pandemic among healthcare team members is an important issue to us.

In the past, there were several studies (6–8) about the association between mental health and biological disasters (like SARS, COVID-19) among healthcare members. A previous study reported that mental health problems were associated with social interaction and the ability to cope with COVID-19 among the general public in Taiwan (9).

In the face of such biological disaster public health incidents like COVID-19, medical staff had massive stress on physical and mental health (10). And past studies (11–15) on the psychological impact of the SARS outbreak in Taiwan have focused on the psychiatric morbidity of medical professionals. In Taiwan's past experience in dealing with SARS, a study by a regional teaching hospital (11) showed that 17.3% of the medical staff involved in the care of SARS patients had obvious psychiatric symptoms. A follow-up study (12) after 3 years found that the medical staff with psychiatric symptoms showed that these symptoms were related to the stress of daily life and were less related to the SARS crisis. Compared with nurses, doctors have a higher ratio of physical symptoms, which indicates that different professionals suffered from different stress of mental health.

For social distance, many studies (16–20) had showed that the effect of social distance on COVID-19 was very important. Increasing social distance can significantly reduce the infection rate of COVID-19 (19). In a past study (21), a massive impact of COVID-19 and previous epidemics like SARS on social activities was found. As we know, social distance during the COVID-19 pandemic is necessary to everyone. On the other hand, the interference on social activities may have substantial mental health impacts (22).

For social anxiety, a study (23) indicated a high proportion of anxiety symptoms (35.1%) among the Chinese in China from the online data during the COVID-19 pandemic. Another study (24) also indicated higher levels of anxiety were correlated with social isolation and quarantine during the SARS pandemic. Past study (18) showed that high social anxiety predicted higher perceptions of illness and lower judgments of trustworthiness. Another study (25) found that anxiety was associated with stress and reduced sleep quality, and the combination of anxiety and stress reduced the positive effects of social capital on sleep quality. A Taiwanese study demonstrates that excessive anxiety because of COVID-19 is associated with lower subjective psychological well-being (26).

One past study (27) showed that social media related information spreading can strongly affect people's behavior and alter the effectiveness of the countermeasures deployed by governments. The social information may affect the other domains of societal influence. The significant association between receiving information about COVID-19 from more sources and greater confidence was found in healthcare team members (28).

Social adaptation implies the intention of subjects to change their behavior and protect themselves to prevent COVID-19 infection. Several studies (29–33) showed that there were associations between protective behavior and the COVID-19 pandemic. There may be some factors that affect social adaptation of healthcare team members. Let them be willing to change their behavior and reduce the risk of being infected during the COVID-19 pandemic.

For the quality of life among healthcare team members during the COVID-19 pandemic, a past study (34) showed that the quality of life among medical staff was decreased. In a pandemic, healthcare workers face greater risk of infection and undertake higher work intensity as compared with the general population.

About the related factors of quality of life among healthcare team members, physical activity, and higher health literacy were found to protect against anxiety and depression and were associated with higher health related quality of life (35). Unexpectedly, smoking and drinking were also found to be coping behaviors. It is important to have strategic approaches that protect healthcare team members' mental health and health related quality of life. Measuring the healthcare workers' risk perception of the COVID-19 and the relevant influential factors can provide the service providers, health policy makers, as well as the health and hygiene instructors with great insights on facilitation of the behaviors aiming at self-effectiveness in improving community health and selecting the best solutions for minimizing the risks arising from this disease. The main aims of this study were (i) to investigate the possible factors to the societal influences and quality of life and (ii) to explore interrelationships and underlying mechanisms between societal influences, mental life quality, physical life quality, and related factors among the healthcare team members in a large psychiatric hospital during the coronavirus infection disease 2019 pandemic in Taiwan.

METHODS

Subjects

A cross-sectional investigation was used in the present study. A total of 716 participants were collected from July 2020 to

Abbreviations: COVID-19, corona virus infection disease 2019; SF-12, Short form-12 items; SISQ, Societal Influences Survey Questionnaire; DRPST, Disaster-Related Psychological Screening Test; SEM, Structural equation model; PTSD, post-traumatic stress disorder; PCS, physical component summary; MCS, mental component summary; SARS, severe acute respiratory syndrome; MERS, Middle East respiratory syndrome; HRQoL, health-related quality of life; PSQI, Pittsburgh Sleep Quality Index.

September 2020 at a psychiatric teaching hospital in southern Taiwan. Only 33 subjects did not complete questionnaires. A satisfactory response rate of 95.3% was thus obtained. Thus, this study consisted of 683 health care workers, including 44 physicians, 283 nurses, and 356 other hospital healthcare workers. The inclusion criteria were: (1) participants who worked at a large psychiatric hospital in southern Taiwan, (2) could understand the objective of the study and follow the instructions from research assistants, (3) aged between 20 and 65 years, and (4) informed consent was obtained from all subjects before filling in the questionnaire. Data with missing values or from those who could not complete the questionnaire were excluded. This study was approved by the Institutional Review Board of KSPH (KSPH-2020-03) and conducted according to the current revision of national legal requirements (Human Subjects Research Act, Taiwan).

Societal influences, quality of life, posttraumatic stress disorder (PTSD) symptoms, levels of depression, sleep disturbance, and related demographic variables were collected through self-reported questionnaires.

T-test and Chi-square test were performed on the demographic variables and questionnaires between nursing staff and non-nursing staff. Multiple linear regression analyses were conducted to ascertain whether the independent factors were associated with dependent variables, including societal influences and quality of life (MCS and PCS). Structural equation model (SEM) was used to explore the possible factors to the societal influences and quality of life among healthcare team members in a psychiatric hospital. We also try to find out the associations of other latent variables and their relationship to PTSD scales (PTSD severity score and PTSD frequency score), level of depression, and sleep disturbance by path analysis.

Measures

Demographic Data

Data was recorded with the participants' age, educational years, marital status, gender, religion, types of work in the hospital, smoking (yes: currently smoking more than five cigarettes a day or no), alcohol use (≥ 3 times per week or not), Exercises habits (≥ 3 days per week or not), participation in social activities (participate in clubs, volunteer or charity activities or not), regular intake (three or four meals a day, ≥ 5 days per week or not), chronic physical illness within 1 year, and history of hypertension and diabetes. All of the demographic information was identified as categorical variables except age and educational years were continuous variables.

Societal Influences Survey Questionnaire (SISQ)

The Societal Influences Survey Questionnaire (SISQ) was constructed to measure the psychological and social impact on individuals during the COVID-19 pandemic. With acceptable validity and reliability, the 15-item SISQ contains five categories of assessment: social distance, social anxiety, social desirability, social information, and social adaptation (36). Ten of the questions were selected in the current study with four domains: social distance, social anxiety, social information, and social adaptation. Cronbach's alpha of 10-item SISQ was 0.817 in the

study. The overall internal consistency coefficient (Cronbach's α) of the 15-item questions SISQ was 0.74 in our past study (36). And Cronbach's alphas were 0.76/0.70/0.56/0.54 among social distance/social anxiety/social information/social adaptation four domains. We adapted 10-item SISQ in our study. Each question was scored on a 4-point Likert scale, with scores ranging from 1 (*never*) to 4 (*often*). Higher total scores of each domain (social distance, social anxiety, social information, and social adaptation) indicated higher compliance to maintain social distance, higher level of anxiety due to COVID-19, more desire to seek related information, and more awareness of progress of the pandemic overseas, respectively. Our past study (36) demonstrated that the SISQ has acceptable reliability, with Cronbach's alphas ranging between 0.57 and 0.76. The SISQ accounted for 58.86% and satisfied the requirement of Kaiser–Mayer–Olkin values (0.78) and significant Bartlett's Test of sphericity. Moreover, the confirmatory factor analysis fit indices also indicated the adequacy of the model.

Short Form-12 Items Health Survey (SF-12)

The 12-item Short Form Survey version 2 (SF-12v2) is based on scoring coefficients derived from version 1 of the SF-36. It was developed to rapidly estimate general health status and has since been well-validated (37). The Short form-12 items health survey (SF-12) (38) is one of the most commonly used health-related quality of life (HRQoL) questionnaires, and it has become widely used in community-based health surveys and physical and mental illness outcome assessments due to its brevity and psychometric performance (39, 40). A recent study (41) showed that PCS and MCS demonstrated high internal consistency (Cronbach's α –PCS: 0.87, MCS: 0.86) and good and moderate test-retest validity, respectively (intraclass correlation coefficient: PCS: 0.79, MCS: 0.59). A previous study (42) reported acceptable to good levels of reliability for PCS internal consistency coefficient (ICC) (Cronbach's $\alpha = 0.78$) and MCS ICC (Cronbach's $\alpha = 0.60$).

These items were graded on a 5-point Likert scale, with scores ranging from 1 (*not at all*) to 5 (*extremely*). A higher score represented a higher level of interference. And the questionnaire contained two components which were mental component summary (MCS) and physical component summary (PCS). So the score of SF-12v2 was divided into “PCS value of SF-12” and “MCS value of SF-12.”

Depression Score

Depression Scales From the Disaster-Related Psychological Screening Test. The level of depression was measured using three questions from the Disaster-Related Psychological Screening Test (DRPST). The DRPST has been shown to be reliable and well-validated to rapidly screen for major depressive disorder or posttraumatic stress disorder (PTSD) after a disaster (43, 44). Three items were used to estimate the status of depressed mood, fatigue or loss of energy, and worthlessness which had persisted for more than 2 weeks in the recent 1 month. Each item was rated on a 2-point Likert scale, with scores ranging from 0 (*no*) to 1 (*yes*). In a past study (44), a score of 2 or more on the depression scale of DRPST was used to define positive cases of major

depressive disorder, giving a sensitivity of 92.1%, specificity of 98.3%, positive predictive value of 83.3%, and negative predictive value of 99.3%. Higher total scores of the three items indicated higher levels of depression. Details of the questionnaire are listed in **Supplementary Table 1**.

Sleep Score

Sleep Disturbance Scales From the Pittsburgh Sleep Quality Index. The Pittsburgh Sleep Quality Index (PSQI) was initially developed to measure the sleep quality in clinical populations, and it has been shown to have good validity and reliability (45). A global PSQI score > 5 yielded a diagnostic sensitivity of 89.6% and specificity of 86.5% ($\kappa = 0.75$, $p \leq 0.001$) in distinguishing good and poor sleepers. And it indicated a reliability coefficient (Cronbach's α) of 0.83. Four items selected from the PSQI were used to estimate the level of sleep disturbance: difficulty to fall asleep, waking up in the middle of the night, subjective sleep quality, and enthusiasm in the recent 1 month (**Supplementary Table 1**). Each item was rated on a 4-point Likert scale, with scores ranging from 1 to 4. Higher total scores of the four items indicated more severe sleep disturbance.

Post-Traumatic Stress Disorder (PTSD) Symptoms

Post-Traumatic Stress Disorder (PTSD) Scales From the Disaster-Related Psychological Screening Test. The levels of PTSD symptoms were measured using eight questions from the Disaster-Related Psychological Screening Test (DRPST). The DRPST has been shown to be reliable and well-validated to rapidly screen for major depressive disorder or post-traumatic stress disorder (PTSD) after a disaster (43, 44). A score of 3 or more on the PTSD scale of DRPST was used to define the positive cases; this resulted in the most appropriate sensitivity (97.8%) and specificity (96.6%), a positive predictive value of 76.3%, and a negative predictive value of 99.8%. The PTSD scales divided into two components: PTSD severity score and PTSD frequency score. Eight items of PTSD severity and PTSD frequency were used to estimate the status of PTSD in the recent 1 month. Each item was rated on a 5-point Likert scale, with scores ranging from 1 (PTSD severity: no distress; PTSD frequency: never) to 5 (PTSD severity: extremely distress; PTSD frequency: every day). Higher total scores of the eight items indicated higher levels of PTSD severity and PTSD frequency. Details of the questionnaire are listed in **Supplementary Table 1**.

Statistical Analysis

Because nursing staff accounted for a large proportion of the overall number of nursing staff in the hospital, and in our study, 283 of all 683 cases were nursing staff, accounting for 41.5%, and nursing staff often had to work in shifts. The work style is different, so we divide all cases into two groups of nursing staff and non-care staff. *T*-test and Chi-square test were performed on the demographic variables and questionnaires between nursing staff and non-nursing staff. Marital status was transformed into a dichotomous variable as “married” (married and remarried) or “unmarried” (single, widowed, cohabiting, and divorced) (**Supplementary Table 2**). Histories of chronic illness

were also transformed into dichotomous variables as “yes” or “no” (**Supplementary Table 3**).

The data were analyzed using the IBM SPSS Statistics for Windows, Version 21.0 (IBM Corp. Released 2012. Armonk, NY: IBM Corp). Baseline characteristics and the scores of questionnaires were compared using an independent *T*-test or the chi-square test. Multiple linear regression analyses were conducted to ascertain whether the independent factors were associated with dependent variables, including SISQ total score_10, PCS value of SF-12, and MCS value of SF-12. The alpha level was set at 0.05.

The normality of dependent variables was checked using the Kolmogorov-Smirnov test. Because non-normally distributed samples were identified with the significance of the test ($p < 0.001$), bootstrapping multiple linear regression with 1,000 bootstrap samples was used to verify the results from the stepwise multi-variate linear regression analysis. In the bootstrapping method, 95% confidence intervals were used to determine statistical significance, as this could qualify the stability of the regression coefficients and reduce the length of the confidence interval (46). When the 95% confidence interval of a regression coefficient did not contain zero, the variable was statistically significant. In addition, the number of bootstrap samples was set as 1,000 to obtain sufficiently accurate 95% bootstrap percentile (47).

The AMOS 21.0 (SPSS, Chicago, IL, USA) was used to analyze the structural equation model (SEM). SEM uses the chi-square fit test to investigate the overall fit into the model; chi-squares resulting in $P > 0.05$ and an adjusted goodness-of-fit index > 0.9 indicated that the model adequately describes the observed data. Root Mean Square Error of Approximation (RMSEA) is based on the non-centrality parameter. Good models have an RMSEA of 0.05 or less. Models whose RMSEA is 0.10 or less were necessary (48). Values for the SRMR range from 0 to 1.0 with well-fitting models obtaining values < 0.05 (49, 50), however values as high as 0.08 are deemed acceptable (51).

Furthermore, we explore the possible factors to the societal influences and quality of life among healthcare team members in a psychiatric hospital by SEM. We also try to find out the associations of other latent variables and their relationship to quality of life, PTSD scales, depression, and sleep by path analysis.

RESULTS

A total of 716 participants were collected from July 2020 to September 2020 at a large psychiatric teaching hospital in southern Taiwan. Only 33 subjects did not complete questionnaires. A satisfactory response rate of 95.3% was thus obtained. And 33 subjects who did not complete questionnaires were older and had fewer education years than 683 subjects who completed questionnaires. In other demographic data (like gender, different healthcare professions, smoking, or not), there were no statistically significant differences. Thus, this study consisted of 683 health care workers, including 44 physicians, 283 nurses, and 356 other hospital health care workers.

TABLE 1 | The difference of demographic data and questionnaires between nursing staff and non-nursing staff.

	Non-nursing staff (<i>n</i> = 400)	Nursing staff (<i>n</i> = 283)	χ^2	<i>T</i>	<i>P</i> -value
Male	137 (34.3%)	33 (11.7%)	45.238		<0.001
Married	198 (49.6%)	111 (39.2%)	7.229		0.007
Had religion	273 (68.3%)	165 (58.3%)	7.127		0.008
Smoking	36 (9.0%)	6 (2.1%)	13.593		<0.001
Alcohol use	47 (11.75%)	32 (11.3%)	0.032		0.859
Exercises habits	279 (69.8%)	131 (46.3%)	38.018		<0.001
Regular intake	357 (89.3%)	196 (69.3%)	42.985		<0.001
Participate in social activities	98 (24.5%)	24 (8.5%)	28.989		<0.001
Chronic physical illness within 1 year	86 (21.5%)	41 (14.5%)	5.384		0.020
Hypertension	28 (7.0%)	9 (3.2%)	4.752		0.029
Diabetes mellitus	17 (4.3%)	3 (1.1%)	5.958		0.015
Age	42.5 ± 10.8	34.9 ± 8.4		97.569	<0.001
Education years	16 ± 3	16.3 ± 1.7		2.689	0.101
Total score SISQ	27 ± 6.1	26.6 ± 6.4		0.428	0.513
Social distance	11.8 ± 3.1	11.4 ± 3		3.385	0.066
Social anxiety	4 ± 1.6	4.3 ± 1.7		6.046	0.014
Social information	5.1 ± 1.6	4.9 ± 1.6		3.894	0.049
Social adaptation	6 ± 1.9	6.1 ± 1.9		0.093	0.760
PCS value	52.1 ± 5.5	51.4 ± 6.1		2.855	0.092
MCS value	48.8 ± 9.7	46.2 ± 8.8		13.259	<0.001
Depression score	0.3 ± 0.8	0.4 ± 0.8		0.723	0.396
PTSD frequency score	2.6 ± 3.8	2.7 ± 3.7		0.021	0.885
PTSD severity score	2 ± 3.1	2.2 ± 3.4		0.675	0.412
Sleep score	4.9 ± 2.4	5.6 ± 2.9		9.281	0.002

SISQ, Societal Influences Survey Questionnaire; PCS, physical component summary; MCS, mental component summary; PTSD, posttraumatic stress disorder.

Demographic Data and Questionnaires Between Nursing Staff and Non-Nursing Staff

In **Table 1**, we used *T*-test and Chi-square test to compare the difference of demographic data and questionnaires between two groups (nursing staff group vs. non-nursing staff group). We found that non-nursing staff group had more male than nursing staff group ($\chi^2 = 45.238$, $P < 0.001$), non-nursing staff were older than nursing staff ($T = 97.569$, $P < 0.001$), more non-nursing staff were married than nursing staff ($\chi^2 = 7.229$, $P = 0.007$), more non-nursing staff had religion belief than nursing staff ($\chi^2 = 7.127$, $P = 0.008$), more non-nursing staff had smoking than nursing staff ($\chi^2 = 13.593$, $P < 0.001$), and more non-nursing staff had exercise habits ($\chi^2 = 38.018$, $P < 0.001$), regular intake ($\chi^2 = 42.985$, $P < 0.001$), and participate in social activities ($\chi^2 = 28.989$, $P < 0.001$) than nursing staff. More non-nursing staff had chronic physical illness than nursing staff ($\chi^2 = 5.384$, $P = 0.020$) within 1 year, more non-nursing staff had hypertension than nursing staff ($\chi^2 = 4.752$, $P = 0.029$), and more non-nursing staff had DM than nursing staff ($\chi^2 = 5.958$, $P = 0.015$). There were no significant statistically differences over alcohol use ($\chi^2 = 0.032$, $P = 0.859$) and education years ($T = 2.689$, $P = 0.101$) between two groups. In the questionnaires, nursing staff group had more social anxiety ($T = 6.046$, $P = 0.014$) and

less social information ($T = 3.894$, $P = 0.049$) than non-nursing staff group. Nursing staff had more sleep disturbance than non-nursing staff under sleep score analysis ($T = 9.281$, $P = 0.002$). Nursing staff had lower score of MCS value than non-nursing staff among SF-12v2 analysis ($T = 13.259$, $P < 0.001$). There were no significant statistically differences over SISQ total score ($T = 0.428$, $P = 0.513$), social distance ($T = 3.385$, $P = 0.066$), social adaption ($T = 0.093$, $P = 0.760$), PCS value of SF-12v2 ($T = 2.855$, $P = 0.092$), depression score ($T = 0.723$, $P = 0.396$), PTSD frequency score ($T = 0.021$, $P = 0.885$), and PTSD severity score ($T = 0.675$, $P = 0.412$).

Multiple Linear Regression for Possible Related Factors of Total SISQ Score

After multiple linear regression (**Table 2**), we found that female ($\beta = 0.143$; $P < 0.001$), older subjects ($\beta = 0.113$; $P = 0.005$), more education years ($\beta = 0.103$; $P = 0.004$), had marriage ($\beta = 0.077$; $P = 0.049$), regular intake ($\beta = 0.109$; $P = 0.003$), and PTSD frequency score ($\beta = 0.313$; $P < 0.001$) all had positive association with SISQ score. After verification with 1,000 bootstrapping multiple linear regressions, the significant related factors were the same as in multiple linear regression (**Supplementary Table 4**).

TABLE 2 | Multiple linear regression for possible related factors of Total SISQ score.

Variable	Beta	t	95% CI		P-value
			Lower bound	Upper bound	
Female	0.143	4.072	1.068	3.058	<0.001
Married	0.077	1.970	0.003	1.919	0.049
Regular intake	0.109	3.030	0.606	2.836	0.003
PTSD frequency score	0.313	8.867	0.402	0.630	<0.001
Age	0.113	2.847	0.021	0.112	0.005
Education years	0.103	2.854	0.079	0.429	0.004

Dependent variable: Total score SISQ.

TABLE 3 | Multiple linear regression for possible related factors of PCS value of SF-12.

Variable	Beta	t	95% CI		P-value
			Lower bound	Upper bound	
Chronic illness within 1 year	-0.160	-4.529	-3.414	-1.349	<0.001
Smoking	-0.076	-2.167	-3.493	-0.172	0.031
Exercises habits	0.147	4.125	0.906	2.553	<0.001
Sleep score	-0.237	-5.755	-0.689	-0.339	<0.001
MCS Value	-0.151	-3.548	-0.143	-0.041	<0.001
PTSD frequency score	-0.200	-4.750	-0.433	-0.180	<0.001
Social Distance	-0.098	-2.725	-0.319	-0.052	0.007

Dependent variable: PCS value of SF-12.

Multiple Linear Regressions for Possible Related Factors of PCS Value of SF-12

After multiple linear regression (Table 3), we found that chronic illness within 1 year ($\beta = -0.160$; $P < 0.001$), smoking ($\beta = -0.076$; $P = 0.031$), sleep score ($\beta = -0.237$; $P < 0.001$), MCS value of SF-12 ($\beta = -0.151$; $P < 0.001$), and PTSD frequency score ($\beta = -0.200$; $P < 0.001$) and social distance ($\beta = -0.098$; $P = 0.007$) all had negative association with PCS value of SF-12. On the other hand, exercise habits ($\beta = 0.147$; $P < 0.001$) had positive association with PCS value of SF-12. After verification with 1000 bootstrapping multiple linear regression, the significant related factors were the same as in multiple linear regression except smoking was excluded from bootstrapping methods (Supplementary Table 5).

Multiple Linear Regression for Possible Related Factors of MCS Value of SF-12

After multiple linear regression (Table 4), we found that age ($\beta = 0.147$; $P < 0.001$), participate in social activities ($\beta = 0.067$; $P = 0.026$), and social information ($\beta = 0.105$; $P = 0.002$) all had positive association with MCS value of SF-12. On the other hand, PTSD frequency score ($\beta = -0.265$; $P < 0.001$), sleep score ($\beta = -0.211$; $P < 0.001$), social anxiety ($\beta = -0.193$; $P < 0.001$), depression score ($\beta = -0.232$; $P < 0.001$), and PCS value of SF-12 ($\beta = -0.093$; $P = 0.003$) all had negative association with

TABLE 4 | Multiple linear regression for possible related factors of MCS value of SF-12.

Variable	Beta	t	95% CI		P-value
			Lower bound	Upper bound	
Age	0.147	4.728	0.077	0.186	<0.001
Participate in social activities	0.067	2.231	0.198	3.106	0.026
PTSD frequency score	-0.265	-7.213	-0.844	-0.483	<0.001
Sleep score	-0.211	-5.855	-1.000	-0.498	<0.001
Social Anxiety	-0.193	-5.415	-1.488	-0.696	<0.001
Social Information	0.105	3.110	0.228	1.009	0.002
Depression score	-0.232	-6.675	-3.629	-1.979	<0.001
PCS Value	-0.093	-3.003	-0.252	-0.053	0.003

Dependent variable: MCS value of SF-12.

MCS value of SF-12. After verification with 1,000 bootstrapping multiple linear regression, the significant related factors were the same as in multiple linear regression (Supplementary Table 6).

The Structural Equation Model (SEM) Showing Interrelationships Between Societal Influences Survey Questionnaire (SISQ), Mental Component Summary (MCS) Value, and Physical Component Summary (PCS) Value of Short Form-12 Items Health Survey (SF-12), PTSD, Age, Sleep Score, Depression Score, Nursing Staff, Gender, Education Years, and Smoking

We used Structural Equation Model (SEM) analysis to explore interrelationships between Societal Influences Survey Questionnaire (SISQ), mental component summary (MCS) value, and physical component summary (PCS) value of Short form-12 items health survey (SF-12), PTSD, age, sleep score, depression score, nursing staff, gender, education years, and smoking. In our SEM model, our P -value is 0.422 (>0.05), adjusted goodness-of-fit index (AGFI) is 0.977 (>0.9), RMSEA is 0.019 (<0.05), and SRMR is 0.0318 (<0.05) which indicated that our model is a good model and adequately describes the data in our study. In Figure 1, we showed that PTSD (two components: PTSD severity and PTSD frequency) had positive influence on SISQ (four components: social information, social adaption, social distance, and social anxiety). Otherwise, sleep score and MCS value both had negative influences on SISQ.

Age had a positive influence on social information and social distance. Education years had a positive influence on social adaption. Nursing staff had a positive influence on social anxiety.

PTSD severity had a positive influence on sleep score and a negative influence on PCS value. PTSD frequency had a positive influence on depression score and a negative influence on MCS value. Depression score and nursing staff had a positive influences on sleep score. Age had a positive influence on MCS value and a negative influence on PCS value. Sleep score and

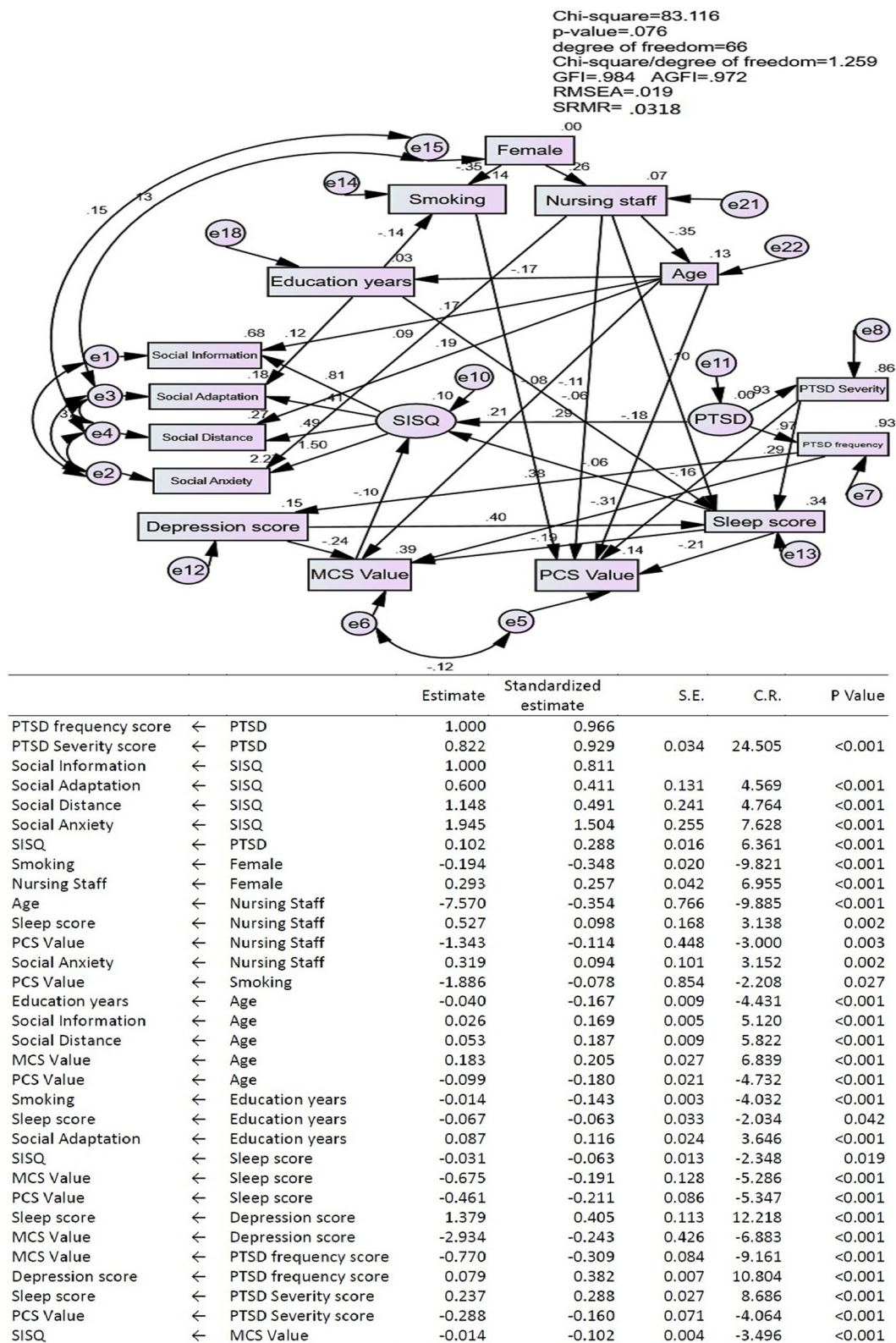


FIGURE 1 | The conceptual model showing interrelationships between Societal Influences Survey Questionnaire (SISQ), mental component summary (MCS) value, and physical component summary (PCS) value of Short form-12 items health survey (SF-12v2), PTSD, Age, Sleep score, depression score, Nursing Staff, gender, education years, and Smoking.

depression score both had negative influences on MCS value. Sleep score, smoking, and nursing staff all had negative influences on PCS value.

Female had a negative influence on smoking and a positive influence on nursing staff. Nursing staff had a negative influence on age. Age had a negative influence on education years. Education years had a negative influence on smoking.

DISCUSSION

To the best of our knowledge, our study is the first study to focus on the related impact factors of societal influences, quality of life, and investigate interrelationships between societal influences, mental health, physical health, post-traumatic stress disorder (PTSD), age, sleep score, depression score, nursing staff or not, and smoking among healthcare team members in a large psychiatric hospital. In multiple linear regressions, PTSD frequency score had positive association with SISQ score. In SEM analysis, PTSD also had positive influence on SISQ. However, sleep score and MCS value both had negative influences on SISQ. We can conclude that healthcare team members who had more severe PTSD symptoms suffered more societal influences in a psychiatric hospital under the COVID-19 pandemic. On the other hand, healthcare team members who had poor sleep and mental health quality had fewer societal influences in a psychiatric hospital during the COVID-19 pandemic. Furthermore, multiple linear regression analysis for possible related factors of social distance, social anxiety, social information, and social adaptation (four domain of SISQ) were used (**Supplementary Tables 7–10**). We found that PTSD frequency score had positive association with four domains of SISQ. Sleep score and MCS value only had negative association with social anxiety.

Depressive score had an indirect negative influence on SISQ by sleep score and indirect positive influence on SISQ by MCS value. We cannot understand whether the healthcare team members with higher depression score would suffer from more societal influences in a large psychiatric hospital during the COVID-19 pandemic. Then we also used ANOVA test to compare the SISQ score between four groups (Depression score = 0, 1, 2, 3, data showed at **Supplementary Table 11**), there was no significant statistical difference between four groups.

The major threat of the COVID-19 pandemic has seriously affected people's mental health (9, 52, 53). And healthcare team members are also under such threats, and their mental health has also been severely impacted (53, 54). Our research focused on the differences in the mental health impacts among different types of healthcare team members who suffered threats in a psychiatric hospital under the COVID-19 pandemic. We found that there is no difference in their total SISQ scores regardless of whether they are nursing staff or not, but the score of nursing staff in social anxiety was higher, while the score of nursing staff in social information was lower, which shows that nursing staff is more anxious in the face of COVID-19 pandemic, but they receive less social information. COVID-19 had more effect on the mental health of non-nursing staff than nursing staff. On the other hand,

we can find that the score of nursing staff in MCS value was lower, while the score of sleep score was higher, which showed that the mental health of nursing staff was poor, and the sleep quality was worse. This may be related to the nature of the work that nursing staff required more shifts.

In the lifestyle analysis, we found that nursing staff had fewer exercise habits, less regular intake, and less participation in social activities which may be due to their working style. Most nursing staff requires shifts among their work that lead to poor lifestyle. A past study (55) showed that 70 nurses (63%) worked nightshifts within the past year and poor sleep quality was the lifestyle factor which most strongly contributed to fatigue.

We also found that the proportion of women in this group of nursing staff is relatively high, and they are younger. Some differences in scale scores, lifestyle (smoking, exercises habits, participate in social activities, regular intake), and the presence or absence of chronic diseases under *T*-test and Chi-square test may be due to differences in gender and age causing this statistically significant difference. It is possible to form Type I error, so we used multiple linear regression analysis to ascertain whether the independent factors were associated with dependent variables, including SISQ score and quality of life (MCS and PCS). And the SISQ, MCS value, PCS value, PTSD symptoms, age, sleep score, depression score, nursing staff or not, gender, education years, and smoking and other related factors were included in the structural equation model (SEM) analysis, so that Type I error caused by the use of *T*-test and Chi-square test can be avoided.

However, a past study (12) about SARS in Taiwan showed that the major difference between the mental health of the nurses and the other healthcare workers was in the somatic realm (headache, palpitations, discomfort in the chest, and numbness of the limbs) in that the nurses had fewer complaints and symptoms. Under SEM analysis in our study, nursing staff had positive influence on social anxiety. Nursing staff had positive influence on sleep score. Nursing staff had negative influence on PCS value. So we need to let our nursing staff get more social information, and nursing staff may need more psychological intervention to improve their social anxiety, sleep disturbance, and life quality during the COVID-19 pandemic in the future.

In the multiple linear regression analysis, PTSD frequency score had positive association with SISQ score and PTSD severity score had no association with SISQ score. We can conclude that relative to PTSD severity score, PTSD frequency score was more important to the societal influences among healthcare team members in a psychiatric hospital during the COVID-19 pandemic. On the other hand, older female and married members suffered from more societal influences during the COVID-19 pandemic. Healthcare team members with higher education level, regular intake suffered from more societal influences during the COVID-19 pandemic. A past study (56) showed that culture factor also had influences on social distance during the COVID-19 pandemic. But we can't consider the culture difference in a single-center study. Sleep score and MCS value only had negative effect to social anxiety, not affecting other domains of SISQ. Another study (57) showed that medical staff had higher anxiety scores and depression scores than general population and the gender, age, marriage, working years,

occupation, educational level, and economic income did not affect anxiety and depression. However, we did not investigate the related questionnaires among the general population in our study.

In the multiple linear regressions, PTSD frequency score had a negative association with MCS value and PCS value of Short form-12 items health survey and PTSD severity score had no association with MCS value and PCS value. We can conclude that relative to PTSD severity score, PTSD frequency score was more important to the quality of life (physical and mental) among healthcare team members in a psychiatric hospital during the COVID-19 pandemic. However, MCS value and PCS had effects on each other which means there was a strong association between the physical component and mental component of quality life. Members with sleep problems may worsen their life quality among physical component and mental component, and a past study (58) also had a similar finding. Members with chronic illness with 1 year, smoking, and fewer exercise habits had poor life quality among physical component, like past studies (59–61). Members with older age, participation in social activities frequently had better life quality on mental component. As in past studies (62, 63), depression can worsen the life quality among mental component. Among the association between societal influences and quality of life among healthcare team members in a psychiatric hospital under COVID-19 pandemic, members with higher social distance scores had poor life quality among physical component. Members with higher social anxiety scores had poor life quality among mental component. Members with higher social information scores had better life quality among mental component.

Limitation of the Study

First, societal influences and quality of life, other related factors like level of depression, sleep disturbance, and PTSD were measured by self-reported questionnaires in our study, and it would have been better if they had been verified through objective observations for related factors in our study. Second, the cross-sectional design of this study limited causal inference for further interpretation. A repeat measurement study may be considered to perform in the future. Finally, a single-center study may limit the generalizability and applicability to other populations.

CONCLUSION

Healthcare team members who had more severe PTSD symptoms suffered more societal influences. Relative to PTSD severity score, PTSD frequency score was more important to the societal influences and quality of life among healthcare team members.

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On the other hand, older female and married members suffered from more societal influences. Health care team members with higher education level, regular intake suffered from more societal influences. Sleep problems may worsen physical life quality and mental life quality, and depression may worsen mental life quality. Members with chronic illness with 1 year, smoking, and fewer exercise habits had poor physical life quality. Members of older age, who frequently participate in social activities had better life quality among mental component.

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 authors.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Review Board of Kai-Syuan Psychiatric Hospital. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

W-TK: conceptualization, methodology, formal analysis, investigation, writing—the main manuscript text, and preparing all figures. S-TH: formal analysis, data curation, and conceptualization. L-SC: methodology and data curation. K-YH and D-JL: methodology and investigation. G-GL, P-JW, and W-JC: investigation. FH-CC: conceptualization, methodology, formal analysis, funding acquisition, project administration, writing—review, and editing. J-JH: conceptualization, formal analysis, writing—review, and editing. All authors have read and approved the manuscript.

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SUPPLEMENTARY MATERIAL

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Gender Differences in Anxiety Among COVID-19 Inpatients Under Isolation: A Questionnaire Survey During the First and Second Waves of the COVID-19 Pandemic in Japan

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This study assesses the gender differences in health and anxiety, especially pertaining to mental health problems and time-course effects. We surveyed 121 patients admitted to a hospital with a COVID-19 diagnosis between March 1 and August 31, 2020. Their mental status was evaluated on admission using the Japanese General Health Questionnaire-28 (GHQ-28) and State-Trait Anxiety Inventory—Form JYZ (STAI). The patients were divided into two groups depending on the period of prevalence, that is, the first and second waves of the pandemic in Japan (from the beginning of March to the end of May 2020, Time 1 = T1; and from the beginning of June to the end of August 2020, Time 2 = T2). A multivariate analysis of covariance revealed significant differences in gender by time interactions in the GHQ-28 subscale “Insomnia and anxiety” and STAI subscale “State-Anxiety.” *Post-hoc t*-tests revealed that the scores of “Insomnia and Anxiety” and “State-Anxiety” were higher in women than in men at T1. However, no difference was observed at T2. Further, “Insomnia and Anxiety” and “State-Anxiety” were significantly higher at T1 than at T2 in female patients. There was no significant difference in males. Thus, female patients were more anxious and depressed in the early phase of the pandemic, whereas male patients had difficulties in coping with anxiety. We suggest more gender-specific mental care, particularly for women at the early stages of infection.

Keywords: COVID-19, anxiety, gender differences, coping, isolation, Japan, mental health

INTRODUCTION

The spread of the coronavirus disease (COVID-19) has been unprecedented in the history of pandemics in the twenty-first century. Since its detection in late 2019, the disease has spread worldwide and has been associated with a spate of medical emergencies and post-recovery health problems, besides being potentially fatal. Despite the lull following the first wave (*primary wave*)

of COVID-19 in Japan, there were signs of a prolonged course of infectious spread and a second outbreak (*secondary wave*). Over the course of this period, experts have accumulated new and more in-depth knowledge of the disease, which has helped establish systems to respond to the pandemic.

Some early studies showed that COVID-19 seriously affects mental health (1–3), while others demonstrated that exposure to it has a minimal direct association with mental health (4). This inconsistency in the impact of COVID-19 on mental health needs to be clarified, to achieve better mental health care for COVID-19 patients. Furthermore, the mental health of COVID-19 patients can also be influenced by factors such as the duration of the pandemic and the way of information dissemination by the media. We started conducting a continuous follow-up mental health survey, including a follow-up planned for after the end of this COVID-19 pandemic, since it has not fully converged so far anywhere in the world, including Japan. Most of the research related to COVID-19 and mental health has only focused on the mental health of the general population. There are a few studies that have examined the mental health of COVID-19 patients who showed more severe symptoms including post-traumatic symptoms, depression, anxiety, and somatic symptoms than control groups (5). It has been reported that 30.2% of patients afflicted with COVID-19 had PTSD, which was more common in women (6). However, little is known about mental health problems in hospitalized inpatients afflicted with COVID-19. Therefore, it would be beneficial to present the basic data of mental health problems in hospitalized COVID-19.

Existing research also confirms gender differences regarding mental health. For example, women predominantly have internalizing symptoms, often because of depression and anxiety, while men tend to experience externalizing symptoms (i.e., violence or substance abuse) (7). Moreover, women seek emotional support to cope with stress more than men (8). As for the gender differences concerning mental health during COVID-19 pandemic, only a handful of reports were found as the period is too limited to accumulate adequate evidence. There is one report which suggests that the factors affecting anxiety and depression differed by gender in COVID-19 patients: male patients whose colleagues were also infected with COVID-19 tended to have more depression and anxiety because colleague infections mean that the workplace of participants may be in the outbreak area, which could company bankruptcy or patient unemployment. Women, however, had higher anxiety depending on their physical symptoms. They were more interested in communicating with medical staff (9). To date, to our knowledge, there is no study considering gender differences at more than one time point in patients with COVID-19. It would be worthwhile to obtain clinical knowledge that contributes to better understanding of mental support strategies, by conducting surveys with patients over time as the situation improves and deteriorates, as there is still no positive prospect of the convergence of the pandemic. Thus, we believe it necessary to investigate gender-based differences in mental health issues among patients of COVID-19. Thus, we believe it necessary to investigate gender-based differences in mental health issues among patients of COVID-19. By specifically considering the

differences in patients' mental health between the primary and the second wave of the pandemic, we comparatively assessed the general health and anxiety of men and women as indices of anxiety/depression at the subclinical level. This exploration can offer gender-specific insights to practitioners caring for the mental health of COVID-19 patients. We hypothesized that women had more severe mental health problems during both the primary and secondary waves of the ongoing pandemic.

METHODS

This study was a single-center retrospective cohort study conducted at Hyogo Prefectural Amagasaki General Medical Center (AGMC), Hyogo, Japan. The number of people with COVID-19 detected in the first and second waves were about 124 and 525 per day (10), respectively. We surveyed 121 patients (mean age = 46.4 ± 17.5 , men = 66, women = 55) who were admitted to the hospital after being diagnosed with COVID-19 using the real-time reverse transcription-polymerase chain reaction test between March 1 and August 31, 2020. Each patient's past medical history was recorded, and they were subsequently isolated in either a single or a quadruple room. We evaluated their mental health status on admission using the Japanese General Health Questionnaire-28 (GHQ-28), which is an instrument for estimating psychosocial well-being (11, 12), and State-Trait Anxiety Inventory-Form JYZ (STAI), which is an instrument used to estimate anxiety (13). The GHQ-28 is a bimodal scoring scale for assessing general health (the score range from 0 to 28). It consists of four subscales (physical symptoms, anxiety/insomnia, social activity, and depression tendency and seven questions for each item). The STAI is a four-point Likert scale that consists of 40 questions that assess state and trait anxiety, ranking it from 1 to 5, with the higher the anxiety, the higher the score. The Japanese version of both GHQ-28 and STAI, which are widely used, have been standardized and published as products (14, 15). The internal consistency reliability of the Japanese version of the GHQ-28 (Cronbach's $\alpha = 0.88$) suggested a high level of reliability (16). The Pearson's correlation coefficient between the GHQ and PSE (Present State Examination) was 0.659. Furthermore, the correlation between the Japanese version of the full scale (GHQ-60) and GHQ-28 was high ($r = 0.9695$), which is indicative of the fact that the Japanese version of the questionnaire was constructed well in terms of reliability and concurrent validity. The internal consistency reliability of the STAI (Cronbach's α) ranged from 0.896 to 0.918 in both trait and state anxiety for both genders, with high test-retest reliability ($r = 0.856$). The correlation between the STAI and Cattle Anxiety Scale was high ($r = 0.67$). These results indicated that the Japanese version of the questionnaire was satisfactory in both its reliability and validity (13). The patients were divided into two groups, depending on the period of prevalence during which they contracted the infection: the primary (Time 1 = T1) and secondary (Time 2 = T2) waves of the pandemic in Japan, that is, from the beginning of March to the end of May 2020, and from the beginning of June to the end of August 2020, in accordance with

TABLE 1 | Group comparisons between male and female patients.

	Male (N = 66)	Female (N = 55)	Gender effect		Time effect		Gender-time interaction	
	M(SD)	M(SD)	F(1)	p	F(1)	p	F(1)	p
GHQ-28^a								
Total score	6.32 (4.77)	8.42 (5.96)	4.972	0.028*	1.015	0.316	1.213	0.273
Physical symptoms ^b	2.70 (2.25)	3.13 (2.36)	1.231	0.270	2.614	0.109	0.464	0.497
Insomnia and anxiety ^b	1.91 (1.86)	2.71 (2.11)	7.796	0.006*	1.053	0.307	5.591	0.020*
Social activity ^c	1.33 (1.77)	1.67 (1.97)	0.785	0.377	0.194	0.660	0.042	0.839
Depression ^c	0.32 (0.77)	0.87 (1.59)	4.420	0.038*	1.082	0.300	0.039	0.843
STAI^d								
State-anxiety	2.70 (0.86)	3.02 (1.10)	6.354	0.013*	2.440	0.121	7.095	0.009*
Trait-anxiety	2.32 (1.00)	2.93 (1.20)	10.119	0.002*	0.022	0.882	2.753	0.100

GHQ-28, General Health Questionnaire-28; STAI, State-Trait Anxiety Inventory; SD, standard deviation; * $p < 0.05$.

^aGHQ-28 consists of four evaluation items (physical symptoms, anxiety/insomnia, social activity, and depression tendency), and each item has seven points. A GHQ-28 total score (a perfect score of 28 points) of more than six points is suggestive of some psychological distress symptoms.

^bA score of more than four points for the items of physical symptoms or Anxiety/Insomnia is suggestive of moderate psychological symptoms.

^cA score of more than three points for the items of social activity or depression tendency is suggestive of moderate psychological symptoms.

^dSTAI consists of two evaluation items (State-Anxiety, Trait-Anxiety), and each item is evaluated on a scale of 1 to 5, and the higher the anxiety, the higher the score.

a formal report by the National Institute of Infectious Diseases in Japan, in which the First Wave in Japan was from January 16 to May 31, and the Second Wave from June 1 to August 19 (10).

Patients received remote medical examinations from psychiatrists through a video call application (FaceTime®) on a tablet device. It was found that 70 patients could not use the device due to the severity of their symptoms, such as COVID-19-induced pneumonia. To prevent infection, we covered the tablet devices, which were exclusively used for the survey, with disposable plastic bags. Those who could not use the video call application on a tablet device were excluded. We determined the patients' psychological state by referring to the GHQ-28 score. This study was approved by the Hyogo Prefectural Amagasaki General Medical Center Institutional Review Board. The participants provided verbal informed consent.

Patients' demographic data were analyzed using two-tailed t -tests or χ^2 -tests. Between-group differences in the data were assessed using a multivariate analysis of covariance (MANCOVA), with gender and time (T1 and T2) as between-subjects factors, the scores of GHQ-28 and STAI as dependent variables, and age and presence of history as covariates. *Post-hoc t*-tests were used to compare the GHQ-28 and STAI scores at each point in time (T1 and T2) for both male and female participants, as well as for comparing the scores at T1 and T2 for each gender. Additionally, the time course changes (from T1 to T2) of these scores were investigated for each gender. Statistical significance was set at $p < 0.05$.

RESULTS

The summary of the demographics for this study was as follows: age was matched between male and female participants both at T1 and T2 [T1: male/female = 47.4 (16.2)/46.9 (15.3), $t = 0.053$, $p = 0.958$; T2: male/female = 45.8 (18.2)/46.2 (18.4), $t = 0.085$, $p = 0.932$]. The number of male and female participants was also matched between T1 and T2 (T1 [male/female = 23/19], T2 [male/female = 43/36], $\chi^2 [1] = 0.001$, $p = 0.972$). No gender difference was found in terms of presence of medical history (male/female = 5/9, $\chi^2 [1] = 2.264$, $p = 0.132$), and the number of participants with medical history did not differ between T1 and T2 (T1/T2 = 6/8, $\chi^2 [1] = 0.464$, $p = 0.496$). The participants answered the GHQ-28 and STAI. A summary of MANCOVA is reported in **Table 1**. In brief, the analyses revealed a significant effect of gender on GHQ-28 scores (total score, anxiety/insomnia, and depression subscales) and STAI scores (state-anxiety, trait-anxiety). No significant effect of time was found in either GHQ-28 or STAI scores. "Gender by Time" interactions were significant in the GHQ-28 subscale of anxiety/insomnia ($F[1] = 5.591$, $p = 0.02$) and state-anxiety ($F[1] = 7.095$, $p = 0.009$). Regarding the effects of covariates on the differences of the GHQ-28 and STAI, neither age ($F[1] = 0.742$, $p = 0.391$, $F[1] = 0.036$, $p = 0.849$ and $F[1] = 0.485$, $p = 0.487$, respectively) nor the medical history ($F[1] = 1.003$, $p = 0.319$, $F[1] = 0.045$, $p = 0.832$ and $F[1] = 3.256$, $p = 0.074$, respectively) showed any effect in the analysis.

Post-hoc t-tests revealed that the GHQ-28 total score and the anxiety/insomnia score were higher in female than male participants at T1 ($t = 2.241$, $p = 0.031$ and $t = 3.504$, $p =$

TABLE 2 | Group comparison by time.

	T1 ^a		Post-hoc test Male/Female	T2 ^b		Post-hoc test Male/Female	Post-hoc test between T1 and T2 in each gender	
	Male M(SD)	Female M(SD)		t(p)	Male M(SD)		Female M(SD)	t(p)
GHQ-28								
Total score	6.22 (4.45)	9.84 (6.02)	2.241 (0.031*)	6.37 (4.99)	7.67 (5.87)	1.060 (0.292)	0.125 (0.901)	−1.296 (0.201)
Physical symptoms	2.91 (2.17)	3.74 (2.60)	1.119 (0.270)	2.58 (2.30)	2.81 (2.19)	0.441 (0.661)	−0.569 (0.572)	−1.406 (0.166)
Insomnia and Anxiety	1.57 (1.47)	3.53 (2.14)	3.504 (0.001*)	2.09 (2.03)	2.28 (1.98)	0.407 (0.685)	1.099 (0.276)	−2.161 (0.035*)
Social activity	1.43 (1.93)	1.89 (1.88)	0.778 (0.441)	1.28 (1.71)	1.56 (2.03)	0.657 (0.513)	−0.337 (0.737)	−0.603 (0.549)
Depression	0.17 (0.49)	0.68 (1.11)	1.862 (0.075)	0.40 (0.88)	0.97 (1.80)	1.760 (0.085)	1.315 (0.193)	0.733 (0.467)
STAI								
State-anxiety	2.57 (0.79)	3.53 (0.77)	3.970 (<i>p</i> < 0.001*)	2.77 (0.90)	2.75 (1.16)	−0.076 (0.940)	0.910 (0.366)	−2.629 (0.011*)
Trait-anxiety	2.13 (1.01)	3.21 (1.08)	3.331 (0.002*)	2.42 (0.98)	2.78 (1.24)	1.434 (0.156)	1.124 (0.265)	−1.280 (0.206)

GHQ-28, General Health Questionnaire-28; STAI, State-Trait Anxiety Inventory; SD, standard deviation; * $p < 0.05$.

^aT1: First wave in Japan, from the beginning of March to the end of May 2020.

^bT2: Secondary wave in Japan, from the beginning of June to the end of August 2020.

0.001, respectively) (Table 2). No gender differences were found in these items at T2 ($t = 1.060$, $p = 0.292$ and $t = 0.407$, $p = 0.685$, respectively).

Similarly, state-anxiety ($t = 3.970$, $p < 0.001$) and trait-anxiety ($t = 3.331$, $p = 0.002$) were higher in female than male participants at T1, but no gender difference was found in these scales at T2 ($t = -0.076$, $p = 0.940$ and $t = 1.434$, $p = 0.156$, respectively). We found that anxiety/insomnia ($t = -2.161$, $p = 0.035$) and state-anxiety ($t = -2.629$, $p = 0.011$) were significantly lower at T2 than T1 in female participants. On the other hand, there was no significant difference in male participants regarding these items ($t = 1.099$, $p = 0.276$, and $t = 0.910$, $p = 0.366$, respectively).

Due to the presence of data that were not normally distributed or not homogeneous in their variance, non-parametric tests were also conducted to confirm the results of MANCOVA analysis. The results of Mann-Whitney U -test were essentially the same as those by MANCOVA analysis (Supplementary Table 1).

DISCUSSION

In this study, we examined the mental health problems of hospitalized COVID-19 patients, focusing on depression and anxiety, during the primary and secondary wave of the pandemic. It is not clear whether anxiety and depression were higher in each subject than before the pandemic with specificity for COVID-19 since there was no comparative reference data of the subjects before COVID-19. However, it would be worthwhile to present the basic data for conducting a longitudinal survey regarding the effects of COVID-19 infection on mental health in the future,

since this pandemic has not been completely converged. The results of this study revealed that women exhibited more anxiety than men did during the primary wave of COVID-19. However, this gender difference disappeared during the secondary wave of infections, with female anxiety presenting less often. The average scores of the GHQ-28 and STAI at T2 for men were higher than those at T1, although this difference was not statistically significant. These findings were partially unexpected given our initial hypothesis; women had to deal with more mental health problems at both time points. Thus, mental health care during a pandemic should be differentiated by gender, and the differences in mental health between the primary and secondary waves of the event should be taken into consideration.

The literature already established that women exhibit anxiety more than men (8). They are also more likely to seek social support, often employing emotion-focused coping strategies. However, men take a more problem-focused approach (17). The high-anxiety trait in women could be responsible for their high scores for anxiety/insomnia, state-anxiety, and trait-anxiety at T1 in our study.

In the secondary wave, a greater prevalence of information on the pandemic may have reduced patient anxiety. The improvement in the anxiety/insomnia and state-anxiety scores for women may be attributed to their emotion-focused skills, such as better interpersonal communication abilities (18–20). This may have benefited them during recovery.

Some studies showed that men are more emotionally inhibited than women (21). One possible interpretation for the absence of significant improvement of the GHQ-28 and STAI scores in male subjects might be due to the lack of communication in

male patients, which could have contributed to greater anxiety. Although the quantity of information on the virus and disease increased at T2, it has been suggested that COVID-19-related mental health problems such as suicides (22) and the complex grief of bereaved families may increase (23). The course of the pandemic is still unpredictable. We thus attribute the lack of improvement in men's GHQ-28 and STAI scores at T2 to the inability to apply problem-focused strategies to cope with the pandemic, although the direct assessment of communication skills would be considered in a further follow-up survey.

To summarize, female patients with COVID-19 were more anxious during the primary wave of the pandemic, whereas male patients might have had difficulties in coping with anxiety, considering the lack of improvement in their mental health over time. We concluded that women may need more care in the early phase of a crisis, whereas men might need care during the follow-up period. We do reiterate that thorough mental care for all COVID-19 patients is important, regardless of gender.

This study has several limitations. First, we could not compare the results of the same patient sample based on their hospitalization periods. Strictly speaking, the design of the current study is a repeated cross-sectional one at two-time points. Therefore, the results of the current study should be interpreted with caution. A longitudinal follow-up study on the same participants would be needed to investigate the changes in their psychological status over time. Second, factors such as socioeconomic ones which potentially influence mental status could not be considered because of the lack of substantial information in the current study. Third, patients with moderate to severe COVID-19 infection could not complete the questionnaire owing to their ill-health. Fourth, the sample size was relatively small. We believe that assessing severe cases with larger sample sizes, for example, by conducting a multi-institutional joint research in a longitudinal follow-up design, can be a fruitful endeavor to understanding care during a pandemic. Finally, only subjective measures were included in this study. Future studies should obtain objective and subjective data to improve the validity of the survey.

CONCLUSION

Female participants with COVID-19 infection were more anxious during the early phase of the pandemic, whereas both genders showed similar attitudes in the secondary wave, with female anxiety presenting less often than those in the first wave.

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Gender-specific mental care is needed, particularly for women at an early stage of an epidemic.

DATA AVAILABILITY STATEMENT

The data analyzed in this study is subject to the following licenses/restrictions: data usage for secondary purpose has not been approved by Institutional Review Board of Amagasaki General Medical Center. Requests to access these datasets should be directed to Hironobu Fujiwara, hirofuj@kuhp.kyoto-u.ac.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Hyogo Prefectural Amagasaki General Medical Center Institutional Review Board. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

RT, HF, YK, NI, MS, KM, and HM conceived and designed the study. RT and HF contributed to the data analysis and interpretation, along with the drafting of the manuscript. YK contributed to the drafting of the manuscript. KM contributed to the revision of the critical analysis. RT, NI, and MS contributed to the data acquisition. All authors approved the final manuscript for submission and agreed to be accountable for all aspects of the work, including the assurance that questions related to the accuracy or integrity of any part are appropriately investigated.

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Anxiety and Perceived Risk in Red Cross Volunteer Personnel Facing the Coronavirus Disease 2019 Pandemic

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In the current situation of sanitary emergencies, humanitarian organizations and their volunteers are playing an important role in the coronavirus disease 2019 (COVID-19) pandemic. A study is proposed that includes a network of volunteers who perform humanitarian activities during the COVID-19 pandemic to assess anxiety, perceived risk, and response behaviors and to explore their relationship with sociodemographic variables. For data collection, an online questionnaire was developed through the Google Forms® platform, where the perceived risk, anxiety, and behavioral responses of the general population to the Influenza A (H1N1) pandemic were assessed. The survey presented is a modified version of that survey adapted for COVID-19. This adaptation was endorsed by an experts committee made up of the health chief of the Ecuadorian Red Cross, the focus point of operations from the International Federation of the Red Cross in Ecuador, and a member from the Health Unit of the Americas Regional Office of the International Federation of the Red Cross. A significant relationship has been shown between the job situation and perceived risk and anxiety, being the staff who worked full time away from home, which was exposed to greater risk and anxiety. Both perceived risk and perceived anxiety are very high (according to a 5-point Likert scale). Knowing these data from this first-line personnel will allow adopting measures that could be beneficial for stress management and, therefore, contribute to the well-being and support of these humanitarian and volunteer organizations in the worldwide response to COVID-19.

Keywords: anxiety, perceived risk, COVID-19 pandemic, cooperation, humanitarian aid, volunteer staff

INTRODUCTION

The epidemic caused by the coronavirus disease 2019 (COVID-19) in China was a threat to global health and represents the largest outbreak of atypical pneumonia since that of the Severe Acute Respiratory Syndrome (SARS) in 2003 (Wang et al., 2020a; WHO, 2020). Few weeks after the initial outbreak, the total number of cases and deaths surpassed those of SARS (Hawryluck et al., 2004). The outbreak manifested itself for the first time, in December 2019, when it was discovered that some groups of pneumonia cases of unknown etiology were associated with the exposure epidemiologically linked

to a seafood market and untracked exposures in the city of Wuhan, province of Hubei (Nishiura et al., 2020). Since then, the number of cases has been increasing exponentially both in and outside Wuhan, extending to the 34 Chinese regions by January 30, 2020 (Wang et al., 2020b). That same day, the WHO declared that the COVID-19 outbreak was a global health problem classified as an international emergency (Mahase, 2020).

In addition to physical harm, COVID-19 also has a severe impact on mental health. This impact is seen on the general population, which shows behaviors related to the anxiety caused by the significant shortage of medical masks and hydroalcoholic gel in China. An important mental health burden is identified in the Chinese population during the COVID-19 outbreak, people who spent too much time thinking about the outbreak and health workers with a high risk of presenting psychological problems (Huang and Zhao, 2020).

There are several studies assessing perceived anxiety in the health personnel who performed tasks in pandemics (Wu et al., 2009). Consequently, the health personnel who performed tasks related to the Middle-East Respiratory Syndrome (MERS) had the highest risk of presenting symptoms of traumatic stress disorder, even after 2 months (Lee et al., 2018).

The health workers who responded to the spread of COVID-19 reported high rates of depression and anxiety symptoms, and insomnia, and anguish (Lai et al., 2020). It was discovered that most of these workers feel that they worked undertaking a significant personal risk, in a setting about which they are not properly informed, playing a role for which they are not sufficiently trained. Each worker must better understand the setting and the importance of their personal role in these environments (Balicer et al., 2006a). Despite the common mental health disorders among patients and health workers, most of these professionals working in isolation units and hospitals do not receive any training to provide mental healthcare (IFRC, 2020a).

In the current situation of sanitary emergency, humanitarian organizations and their volunteers play an important role in the COVID-19 pandemic, providing services to those affected (IFRC, 2020a). Armed conflicts, natural disasters, and other emergencies have an immense impact on long-term mental health and psychological well-being, including the volunteers who work in the entire context (von Keudell et al., 2016). Hence, the importance of preserving the well-being of these volunteers, taking their mental health into consideration (IFRC, 2020b). There are studies assessing perceived anxiety in the health personnel who performed tasks in pandemics (Lee et al., 2018), but not in volunteer personnel from humanitarian organizations who perform tasks in pandemics. It becomes necessary to study the psychological impact on the mental health of the medical workers and the communities to prepare for the response of a population to a disaster (von Keudell et al., 2016).

The perceived risk among the public health workers and the humanitarian-aid volunteers is associated with several factors, which are peripheral to the real peril of this event (IFRC, 2020b). These modifiers of the risk perception and the knowledge gaps identified to act as barriers to responding to the pandemic and

must be specifically addressed to allow for an effective public health response (Balicer et al., 2006b).

In the general population, the uncertainty with which an outbreak of this magnitude is confronted becomes especially pertinent. Most of the population classifies the psychological impact as moderate or severe, with depression, anxiety, or stress being more prevalent (Wang et al., 2020b). There are tools to assess and predict health behaviors (such as depression, anxiety, and perceived risks) based on the Protection Motivation Theory (Conner and Norman, 2005) and on the Model of Health Beliefs (Champion and Skinner, 2008), which have been used in different studies (Brug et al., 2004; Bults et al., 2011).

The level of perceived risk related to the disaster will be influenced by the level of awareness and knowledge of a person (Commodari, 2017). The governmental programs aimed at enhancing such knowledge and awareness exert an influence on the perceptions of people and can help a society to be better prepared and to have greater control of a disaster situation. However, such programs can also have detrimental effects, as a result of the increase in the anxiety levels of individuals (Wu et al., 2009).

Given the above results, a study is proposed that includes a network of volunteers who perform humanitarian activities during the COVID-19 pandemic to assess anxiety, perceived risk, and response behaviors and to explore their relationship with sociodemographic variables. The data obtained gave us information on the psychological well-being of its volunteers, contributing to maintaining these personnel and recruiting new volunteers, thus, ensuring the quality of the service provided (Council of the Delegates of the International Red Cross Red Crescent Movement, 2019; IFRC, 2020b).

MATERIALS AND METHODS

Study Design and Participants

A cross-sectional, observational, and descriptive study is conducted to assess the level of anxiety, perceived risk, and behavioral responses in the face of the COVID-19 pandemic with a group of intervening volunteers from the Ecuadorian Red Cross who are to perform humanitarian tasks.

The study population consisted of volunteers and hired intervening personnel from the Ecuadorian Red Cross that was imminently going to execute operational activities related to the pandemic in its entire Territorial Network. The population was accessed through the participants of the "Induction plan: Handling of Personal Protective Equipment (PPE) and application of protocols to the activities of operatives in the territorial network" that was developed by the Ecuadorian Red Cross, where it was foreseen that the institutional humanitarian personnel would receive information by means of a virtual platform to theoretically level up knowledge on the adequate use and handling of PPE in the response to the pandemic.

The following inclusion criteria were used to participate in the sample:

- Being intervening personnel belonging to cities defined as of immediate intervention, where five branches were located: Guayaquil, Quito, Babahoyo, Portoviejo, and Cuenca.

- Not belonging to groups vulnerable to COVID-19 or living in the same household with people from the vulnerable group, which, according to the WHO criteria, are as follows: individuals over 65 years old, immuno-depressed patients, and people with concomitant diseases, such as cardiovascular or respiratory conditions, cancer, and cerebrovascular diseases.

In these five aforementioned branches, there are 312 intervening volunteers available, selecting those who participated in the first phase of the plan, where all were screened by the Ecuadorian Red Cross through an affiliation interview to verify and responsibly declare, among other issues, that no intervening volunteer belonged to any risk group vulnerable to COVID-19 or lived in the same household with people belonging to these groups. In the first phase, the participants were 115 volunteers. A sample size calculation was performed with a 95% CI and an expected frequency of 50%, the minimum sample size being 89 subjects. Finally, 90 subjects were recruited in this study.

Data Collection

For data collection, an online questionnaire was developed through the Google Forms® platform, where the perceived risk, anxiety, and behavioral responses of the general population to the Influenza A (H1N1) pandemic were assessed (Bults et al., 2011). This scale has a good reliability value (KMO 0.94) with a Cronbach's alpha coefficient of 0.85. The survey presented is a modified version of that survey adapted for COVID-19. This adaptation was endorsed by an experts committee made up of the health chief of the Ecuadorian Red Cross, the focus point of operations from the International Federation of the Red Cross in Ecuador, and a member from the Health Unit of the Americas Regional Office of the International Federation of the Red Cross.

The sociodemographic variables used in the descriptive study were as follows: gender, age, type of housing, marital status, schooling level, having pets, and work situation. The questionnaire also assessed variables referring to the evaluation of the information sources, and quantity and quality of the information received about COVID-19, and also an assessment of knowledge on COVID-19. Of all these, the following are considered as independent variables for the exploratory hypotheses: gender, type of housing, marital status, and information sources.

The data corresponding to the assessment of anxiety, perceived risk, physical symptoms, and behavioral responses were collected through the 26-item questionnaire on the severity level perceived, concern, thoughts, fear, psychosomatization, and habitual practices by using a 5-point Likert-type scale. This scale structures these 26 items in four categories: anxiety, perceived risk, physical symptoms, and behavioral responses. The values of these categories were considered as dependent variables in the exploratory hypotheses.

Statistical Analysis

Data analysis was performed with the Epi Info version 7: Centers for Disease Control and the World Health Organization and IBM SPSS version 24: International Business Machines

Corporation tools. For the descriptive analysis of the qualitative variables, the relative and absolute frequencies were calculated with 95% CI, whereas for the quantitative variables a numerical summary was conducted by calculating the centralization and dispersion measures.

To contrast the exploratory hypothesis, a bivariate analysis was performed between the set of sociodemographic variables/information sources and the variables of anxiety/perceived risk/physical symptoms/behavioral responses; all the dependent variables were recorded. The answers given by all the individuals to the items corresponding to each dependent variable were added up, calculating the answer total mean value of each. The individuals who obtained an average below this total mean value in the items of this variable were considered as a "low or very low" value, and those who obtained an average above the total mean value of the dependent variable were considered as a "high or very high" value, by using a methodology for recoding and for establishing cut-off points, very similar to that of other studies (Ragland, 1992; Maxwell and Delaney, 1993; Cumsille and Bangdiwala, 2000). The independent variable related to the information media was dichotomized, grouping official, information sources in one group and non-official information sources in another.

Ethical Considerations

The study was reviewed and approved by the Ethics Committee for the Red Cross Nursing School of the University of Seville. The privacy of participants was preserved so that the questionnaire was completely anonymous, including informed consent for their participation. Throughout the data collection process, the ethical principles for medical research in human beings described in the latest review of the Declaration of Helsinki conducted in Brazil were applied (Asociación Médica Mundial, 2013). Authorization was obtained from the International Federation of the Red Cross and the Ecuadorian Red Cross.

RESULTS

Of the 312 volunteers from the five branches of the Ecuadorian Red Cross intended to receive the initial training for the response to COVID-19, the final convenience sample was made up of 90 participants, which corresponded to the definite number of volunteers who voluntarily answered the online questionnaire before the first session of the training program on the virtual platform devised for such purpose. Regarding the sociodemographic description of the sample, 55.5% were women ([95% CI: 44.7–66] $n = 50$), and the mean age of the participants in the sample was 29.5 years old (SD: 9.2). In relation to the type of housing, 56.7% of the participants ([95% CI: 45.8–67.1] $n = 51$) live in a house with a garden or a yard. About 24.4% of the participants were married or lived with a partner ([95% CI: 16–34.6] $n = 22$) and 46.7% of them had completed high school ([95% CI: 36.1–57.5] $n = 42$). Regarding the work situation, 20% of the participants were working full time outside their homes ([95% CI: 12.3–29.7] $n = 18$). The detail of all the results from the

TABLE 1 | Sociodemographic results of the sample.

Variables	Items	Absolute frequency (n)	Percentage (%) CI 95%
Sex	Men	40	44.4% (33.9–55.3)
	Women	50	55.5% (44.7–66.0)
Type of living place	Apartment with terrace or patio	5	5.6% (1.8–12.5)
	Apartment without terrace or patio	11	12.2% (6.3–20.8)
	House with garden	51	56.7% (45.8–67.1)
	House without garden	23	25.6% (16.9–35.9)
Marital status	Single	60	66.6% (55.9–36.3)
	Married or living together	22	24.4% (16–34.6)
	Separated, divorced, or widowed	8	8.9% (3.9–16.8)
Educational level	Basic education	2	2.2% (0.3–7.8)
	Secondary education	42	46.7% (36.1–57.5)
	Training cycle education	32	35.6% (25.7–46.4)
	University education	11	12.2% (6.3–20.8)
	Postgraduate: master or doctorate	3	3.3% (0.7–9.4)
Job situation	Full time from home	4	4.4% (1.2–10.9)
	Full time away from home	18	20% (12.3–29.7)
	Part time from home	14	15.6% (8.8–24.7)
	Part time away from home	5	5.5% (2.5–8.5)
	Unemployed	17	18.9% (11.44–28.5)
	Retired	1	1.1% (0.0–6.0)
	Student	31	34.4% (30.4–38.4)
Employment contract	Autonomous	24	26.7% (17.9–37.0)
	Public employee	7	7.8% (3.9–15.4)
	Employment in private company	27	30% (20.8–40.6)
	Other situations	32	35.6% (25.7–46.3)

sociodemographic descriptive analysis of the study participants is given in **Table 1**.

Regarding the perceived severity level imposed by COVID-19, 50% of the sample perceives it as “very high” ([95% CI: 39.3–60.7] $n = 45$). Concern for COVID-19 is “very high” in 44.4% ([95% CI: 33.9–55.3] $n = 40$) of the sample. In relation to the physical symptoms, 21.1% ([95% CI: 13.2–30.9] $n = 19$) of the sample refers to moderate stomach discomfort. Regarding the behavioral responses, frequent hand hygiene is always performed by 80% ([95% CI: 70.2–87.7] $n = 72$) of the sample; and, in relation to the use of masks, 82.2% of the sample ([95% CI: 72.7–89.4] $n = 74$) states using them at all times.

Regarding the efficacy level attributed to the preventive measures, that given to the use of masks before the state of alert is “high” in 55.6% ([95% CI: 44.7–66.0] $n = 50$) of the sample. The efficacy level attributed to the use of masks in the current time is “high” in 81.1% ([95% CI: 71.5–88.6] $n = 73$) of the sample. Regarding the level of confronting, 53.3% of the sample ([95% CI: 42.5–63.9] $n = 48$) states that the situation is worse than what was predicted (**Table 2**).

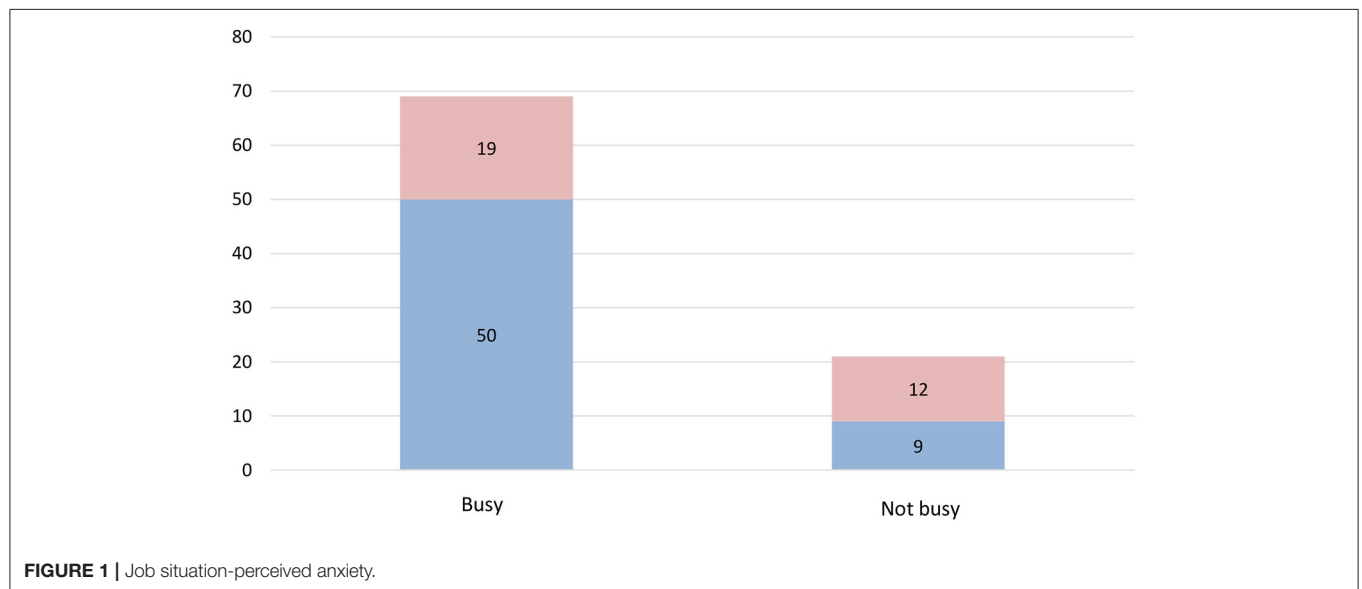
A statistically significant difference is observed between perceived anxiety and type of living place and job situation ($p = 0.029$ and $p = 0.0124$, respectively) (**Figure 1**). No significant results were found in the high values for perceived risk when contrasting them with gender, marital status, job

situation, and type of housing ($p = 0.924$, $p = 0.508$, $p = 0.348$, and $p = 0.211$, respectively). No significant results were found in the high values for behavioral responses when contrasting them with gender, marital status, and job situation ($p = 0.194$, $p = 0.106$, and $p = 0.677$, respectively). However, when comparing the values of the type of housing with the behavioral responses, statistically significant differences were found ($p = 0.024$) (**Figure 2**), since levels of adequate behavioral responses to the COVID-19 were more frequently found in participants who lived in houses (with a garden or a yard, 56.8%; and without them, 82.6%) against those who lived in apartments (with a balcony, a terrace or a yard, 20%; and without them, 45.4%). No significant results were found in the high values for physical symptoms when contrasting them with gender, marital status, job situation, and type of housing ($p = 0.386$, $p = 0.316$, $p = 0.854$, and $p = 0.811$, respectively) (**Table 3**). The variables perceived anxiety, perceived risk, behavioral responses, and physical symptoms did not have a significant relationship with the sources of information (official and unofficial) (**Table 4**).

The level of perceived risk is explained by 29% by the information received, highlighting the most explanatory variables—the accessibility and quantity of information received by the media ($p = 0.003$ and $p = 0.0008$, respectively) and the accessibility, quality, quantity, and utility received from official sources ($p = 0.034$, $p = 0.015$, $p = 0.031$, and $p = 0.018$,

TABLE 2 | Descriptive data on risk and perceived anxiety, physical symptoms, and behavioral responses to coronavirus disease 2019 (COVID-19).

	Frequency (n) Percentage % (95% CI)				
Perceived risk	Very low	Low	Moderate	High	Very high
Degree of perceived severity	2 2.2 (0.3–7.8)	4 4.4 (1.2–10.9)	10 11.1 (5.5–19.5)	29 32.2 (22.7–42.9)	45 50 (39.3–60.7)
Risk of contracting the disease due to age previous pathologies	3 3.3 (0.7–9.4)	8 8.9 (3.9–16.7)	24 26.7 (17.9–37.0)	37 41.1 (30.8–51.9)	18 20 (12.3–29.7)
This disease is very harmful to me	0	7 7.8 (3.18–15.4)	17 18.9 (11.4–28.5)	29 30 (20.8–40.6)	39 43.3 (32.9–54.2)
Perceived susceptibility to getting sick	2 2.2 (0.3–7.8)	8 8.9 (3.9–16.8)	32 35.6 (25.7–46.3)	27 30 (20.8–40.6)	21 23.3 (15.1–36.4)
Possibility of getting infected	1 1.1 (0.0–6.0)	10 11.1 (5.5–19.5)	28 31.1 (21.8–41.7)	28 31.1 (21.8–41.7)	23 25.6 (16.9–35.8)
Possibility of infecting others	2 2.2 (0.3–7.8)	15 16.7 (9.6–26.0)	26 28.9 (19.8–39.4)	30 33.3 (23.7–44.0)	17 18.9 (11.4–28.5)
Perceived anxiety	Very low	Low	Moderate	High	Very high
Concern about COVID-19	2 2.2 (0.3–7.8)	6 6.7 (2.5–13.9)	16 17.8 (10.5–27.3)	26 28.9 (19.8–39.4)	40 44.4 (33.9–55.3)
Fear of COVID-19	3 3.3 (0.7–9.4)	11 12.2 (6.3–20.8)	15 27.8 (18.8–38.2)	22 24.4 (16.0–34.6)	29 32.2 (22.7–42.9)
Frequency of thinking about COVID-19	5 5.6 (1.8–12.5)	25 27.8 (18.8–38.2)	21 23.3 (15.1–33.4)	26 28.9 (19.8–39.4)	13 14.4 (7.9–23.4)
Physical symptoms	Very low	Low	Moderate	High	Very high
Stomach discomfort	30 33.3 (23.7–44.0)	15 16.7 (9.6–26)	19 21.1 (13.2–30.9)	14 15.6 (8.8–24.7)	12 13.3 (7.1–22.1)
Sweat	29 32.2 (22.7–42.9)	16 17.8 (10.5–27.3)	22 24.4 (16.0–34.6)	12 13.3 (7.1–22.1)	11 12.2 (6.3–20.8)
Tremors	52 57.8 (46.9–68.1)	12 13.3 (7.1–22.1)	16 17.8 (10.5–27.3)	8 8.9 (3.9–16.8)	2 2.2 (0.3–7.8)
Tension	31 34.4 (24.7–45.2)	17 18.9 (11.4–28.5)	22 24.4 (16.0–34.6)	11 12.2 (6.3–20.8)	9 10 (4.7–18.1)
Behavioral responses	Never	Almost never	Sometimes	Almost always	Always
I practice frequent hand washing	1 1.1 (0.0–6.0)	0	2 2.2 (0.2–7.8)	15 16.6 (9.6–26)	72 80 (70.2–87.7)
I stay home	3 3.3 (0.7–9.4)	8 8.8 (3.9–16.7)	3 3.3 (0.7–9.4)	17 18.8 (11.4–28.5)	59 65.5 (54.8–75.2)
I always use a mask	0	1 1.1 (0.0–6.0)	2 2.2 (0.2–7.8)	13 14.4 (7.9–23.4)	74 82.2 (72.7–89.4)
I avoid crowded places	1 1.1 (0.0–6.0)	3 3.3 (0.7–9.4)	7 7.7 (3.1–15.3)	16 17.7 (10.5–27.2)	63 70 (59.4–79.2)

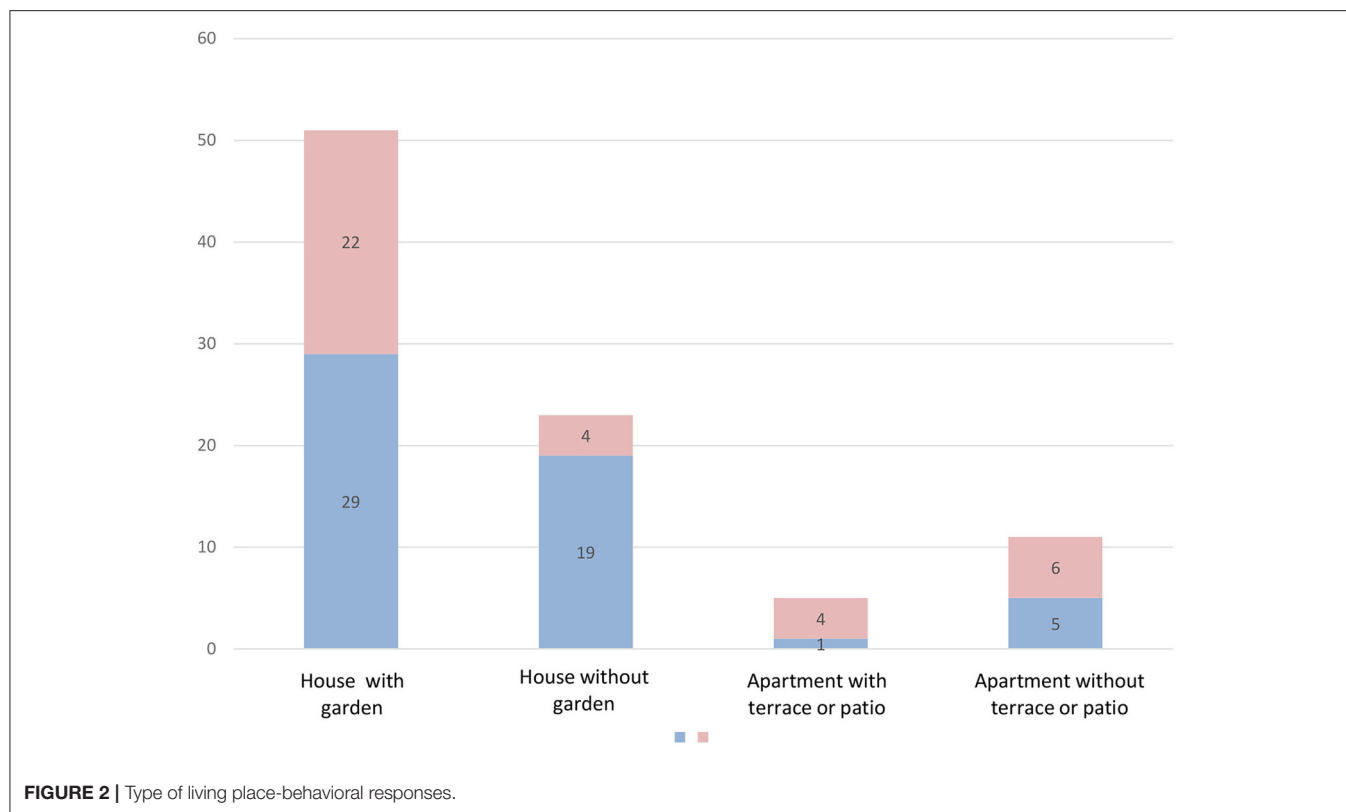


respectively). The level of perceived anxiety is explained only in 18% by this set of variables, highlighting the explanatory variables—the quality of the information ($p = 0.0008$) and the usefulness of the information ($p = 0.016$) received from official sources. The level of behavioral responses is explained by 22%, highlighting the amount of information received from the media ($p = 0.018$) and the accessibility and quality of the information received from official sources ($p = 0.002$ and $p = 0.004$, respectively). Finally, the level of physical symptoms is

explained by only 13%, highlighting the significant use of the information provided by official sources ($p = 0.0128$) (Table 5).

DISCUSSION

The study intended to assess the level of anxiety, perceived risk, and behavioral responses to the COVID-19 pandemic in a group of intervening volunteers from the Ecuadorian Red



Cross, who were initiating their preparation to participate in response activities against the COVID-19 pandemic. The data were collected in the first wave, from April to June of 2020.

Regarding the behavioral responses, a clear strength of this study is observed, since data collection took place during the pandemic, in opposition to other studies conducted at times when the pandemic was based on hypothetical situations (Hong and Collins, 2006; Taylor et al., 2009; Kok et al., 2010).

Regarding its limitations, this is a descriptive and cross-sectional study, with a convenience sample made up of volunteer personnel with a mean age of 29.5 years old, single, and with complete high school. Therefore, the results cannot be extrapolated to the general population, thus limiting external validity. It is a small sample that may be unrepresentative, but it met the minimum necessary sample size. Despite this, the sample turns out to be interesting, as there are few studies addressing the mental health and psychological aspects of intervening volunteers who are to perform humanitarian tasks in the face of a pandemic. The existing studies that address mental health and during COVID-19 pandemic psychological aspects during the COVID-19 pandemic focus on the general population (Galea et al., 2020; Liu et al., 2020), the patients (Lima et al., 2020), and the health personnel (Wu et al., 2009; Min et al., 2018; Lai et al., 2020; Pappa et al., 2020). Understanding the mental health response after a public health emergency might help the communities to prepare for the response of a population to a disaster (Das et al., 2020; Rajkumar, 2020).

Another limitation is the fact that the questionnaire used was adapted from a questionnaire specifically designed for the H1N1 pandemic (Bults et al., 2011). Nevertheless, an adaptation effort was made by a group of experts, who found many common elements between the H1N1 and the COVID-19 pandemics, which result in the non-previsibility of many biases caused by the validity of the instrument employed.

The exploratory analysis performed was bivariate; effectiveness might be increased by conducting a multivariate analysis. Nevertheless, the study object had an exploratory nature, allowing for the establishment of relationships between dependent and independent variables.

Regarding the dichotomization of continuous variables, it becomes necessary to discuss the possibility of substantially modifying the relationships between dependent and independent variables (Cumsille and Bangdiwala, 2000). Some authors suggest that there can be underestimation or underestimation biases about the association (Maxwell and Delaney, 1993). However, it seems that these biases are much more likely when the analyses are based on multiple linear regression models or when the logistic regression models are applicable (Cumsille and Bangdiwala, 1996), situations that do not apply to this study. Consequently, considering that the categorization of the continuous variables has allowed the researchers to avoid the strong assumptions required by these models about the relationship between the variables and the risk assessment, and the “Likert” answer scale for each item consisted of only five points, and it does not seem probable that too much

TABLE 3 | Bivariate analysis between sociodemographic variables and anxiety, perceived risk, physical symptoms, and behavioral responses.

Bivariate analysis	Relative risk	Statistical value, degrees of freedom, statistical significance
Sex-perceived anxiety	0.8 (0.6–1.3)	$\chi^2 = 0.4$; df = 1; $p = 0.502$
Sex-perceived risk	0.9 (0.7–1.4)	$\chi^2 = 0.09$; df = 1; $p = 0.924$
Sex-physical symptoms	1.2 (0.8–1.6)	$\chi^2 = 0.750$; df = 1; $p = 0.386$
Sex-behavioral responses	0.7 (0.5–1.1)	$\chi^2 = 1.668$; df = 1; $p = 0.194$
Type of living place-perceived anxiety	N/A	$\chi^2 = 4.54$; df = 3; $p = 0.029^*$
Type of living place-perceived risk	N/A	$\chi^2 = 4.51$; df = 3; $p = 0.211$
Type of living place-physical symptoms	N/A	$\chi^2 = 0.959$; df = 3; $p = 0.811$
Type of living place-behavioral responses	N/A	$\chi^2 = 9.41$; df = 3; $p = 0.024^*$
Marital status-perceived anxiety	N/A	$\chi^2 = 2.548$; df = 2; $p = 0.280$
Marital status-perceived risk	N/A	$\chi^2 = 1.353$; df = 2; $p = 0.508$
Marital status-physical symptoms	N/A	$\chi^2 = 2.301$; df = 2; $p = 0.316$
Marital status-behavioral responses	N/A	$\chi^2 = 4.48$; df = 2; $p = 0.106$
Job situation-perceived anxiety	1.7 (1.0–2.8)	$\chi^2 = 6.25$; df = 1; $p = 0.0124^*$
Job situation-perceived risk	1.2 (0.8–1.9)	$\chi^2 = 0.878$; df = 1; $p = 0.348$
Job situation-physical symptoms	1.1 (0.3–3.6)	$\chi^2 = 0.033$; df = 1; $p = 0.854$
Job situation-behavioral responses	1.02 (0.9–1.1)	$\chi^2 = 0.173$; df = 1; $p = 0.677$
Educational level-perceived anxiety	0.7 (0.5–1.04)	$\chi^2 = 2.91$; df = 1; $p = 0.088$
Educational level-perceived risk	1.08 (0.7–1.5)	$\chi^2 = 0.231$; df = 1; $p = 0.630$
Educational level-physical symptoms	0.41 (0.1–1.2)	$\chi^2 = 2.73$; df = 1; $p = 0.097$
Educational level-behavioral responses	0.97 (0.9–1.05)	$\chi^2 = 0.392$; df = 1; $p = 0.530$

*Statistically significant $p < 0.05$.

TABLE 4 | Bivariate analysis between information sources and anxiety, perceived risk, physical symptoms, and behavioral responses.

	Frequencies (n)	Relative risk (95% CI)	Statistical value, degrees of freedom, statistical significance
Source of information-perceived anxiety	Official sources 60% (29) Unofficial sources 57% (24)	1.0 (0.7–1.5)	$\chi^2 = 0.099$; df = 1; $p = 0.753$
Source of information-perceived risk	Official sources 60.4% (29) Unofficial sources 50% (21)	1.2 (0.8–1.8)	$\chi^2 = 0.984$; df = 1; $p = 0.321$
Source of information-behavioral responses	Official sources 66.6% (32) Unofficial sources 52.4% (22)	1.2 (0.8–1.8)	$\chi^2 = 1.905$; df = 1; $p = 0.168$
Source of information-physical symptoms	Official sources 54.1% (26)	0.8 (0.6–1.1)	$\chi^2 = 1.458$; df = 1; $p = 0.227$

information has been lost to bias the results (Altman et al., 1994).

Regarding perceived risk, there is a “very high” assessment of the perceived severity level of COVID-19. Similarly, regarding the perceived anxiety variable, there is a “very high” assessment in relation to concern about COVID-19. These are conclusions similar to that of another study in which the prevalence of depression in health personnel during the COVID-19 pandemic is analyzed (Pappa et al., 2020).

Most of the participants obtain information through social networks since the Internet facilitates access to information (Balicer et al., 2006b). Nevertheless, we have witnessed a massive infodemic with the audience being bombarded with a large amount of information, much of which is not scientifically correct (Naeem and Bhatti, 2020), and where the social networks play an important role in the dissemination

of fake news (Ahmad and Murad, 2020; Al Jazeera, 2020), leading to confusion and exasperation in the population (Pew Research Center, 2020). Institutions, such as the International Federation of Library Associations (IFLA), have developed tools on how to detect fake news (IFLA, 2016). The websites of the official public health organizations considered as the best-quality online information source on COVID-19 (Conner and Norman, 2005) remain in this study as the third most used information source, which concedes major responsibility to the governments in relation to general interest sanitary and public health recommendations (Ministerio de Sanidad C y BS, 2020).

Despite the popularity and accessibility of the Internet, no significant association is found between using the Internet as an information source on COVID-19 and the behavioral responses, a result that coincides with a study-relating information source

TABLE 5 | Regression model.

	Information supplied by the media Significance level and coefficient in the regression model (SD included)				Information supplied by official sources Significance level and coefficient in the regression model (SD included)				Correlation <i>F</i> -Statistic coefficient	
	Accessibility	Quality	Quantity	Utility	Accessibility	Quality	Quantity	Utility		
Perceived risk	$p = 0.003^*$ 0.496 (0.164)	$p = -0.226$ 0.207 (0.170)	$p = 0.0008^*$ -0.629 (0.182)	$p = 0.789$ 0.048 (0.179)	$p = 0.034^*$ -0.457 (0.213)	$p = 0.015^*$ 0.598 (0.243)	$p = 0.031^*$ 0.460 (0.210)	$p = 0.018^*$ -0.472 (0.196)	0.29	4.178
Perceived anxiety	$p = 0.453$ 0.128 (0.170)	$p = 0.308$ -0.181 (0.176)	$p = 0.672$ -0.080 (0.189)	$p = 0.221$ 0.229 (0.186)	$p = 0.0738$ -0.400 (0.221)	$p = 0.0008^*$ 0.874 (0.252)	$p = 0.525$ 0.139 (0.218)	$p = 0.016^*$ -0.500 (0.204)	0.18	2.226
Behavioral responses	$p = 0.210$ 0.225 (0.178)	$p = 0.997$ -0.001 (0.185)	$p = 0.018^*$ -0.477 (0.198)	$p = 0.162$ 0.275 (0.195)	$p = 0.002^*$ -0.733 (0.232)	$p = 0.004^*$ 0.766 (0.264)	$p = 0.087$ 0.395 (0.229)	$p = 0.088$ -0.368 (0.214)	0.22	2.921
Physical symptoms	$p = 0.966$ 0.010 (0.230)	$p = 0.743$ 0.078 (0.238)	$p = 0.794$ 0.066 (0.255)	$p = 0.369$ 0.227 (0.251)	$p = 0.844$ -0.059 (0.298)	$p = 0.084$ 0.595 (0.340)	$p = 0.749$ 0.095 (0.295)	$p = 0.0128^*$ -0.700 (0.275)	0.13	1.533

*Statistically significant.

and self-confidence to face COVID-19 (Ajzen, 2002; Galea et al., 2020).

These measures coincide with those recommended by the WHO, where the importance of combining them to enhance their effectiveness is emphasized (bin-Reza et al., 2012). Other studies corroborate the importance of using masks (Cowling et al., 2010; MacIntyre and Chughtai, 2020).

No significant differences are appreciated regarding the perception of anxiety among individuals of different genders (78), which contrast other studies where a significant difference is indeed seen regarding gender during the COVID-19 pandemic or in the H1N1 pandemic, where the most concerned and anguished population segments due to the pandemic were women and aged individuals, more prone than others to adopt some avoidance conducts (Champion and Skinner, 2008; Lau et al., 2010; Taglioni et al., 2013).

Significant differences are appreciated between the type of housing and the behavioral responses adopted. The findings of this study represent an essential first step to understand if housing directly affects the adoption of adequate behavioral responses, since levels of adequate behavioral responses to the COVID-19 pandemic were more frequently found in participants who lived in houses, against those who lived in apartments.

No significant differences are established between marital status and anxiety or perceived risk. One of the reasons can be the reduced sample, though it might be expected that people who face the pandemic alone without a partner or with social distancing can present higher anxiety levels (Galea et al., 2020; Giallonardo et al., 2020). According to Elbay et al. (2020), the level of anxiety was mainly associated with the profile: young, single, with little work experience, and with work in the front line. The increase in weekly working hours, the greater number of patients diagnosed with COVID-19, a lower level of support from their reference people, less logistical support, and less feeling of competence during development were predictive factors of stress and anxiety development of tasks.

In conclusion, it was possible to assess anxiety, perceived risk, and response behaviors in the volunteer personnel during the COVID-19 pandemic. Both perceived risk and perceived anxiety are very high. However, the behavioral responses adopted are adequate.

A significant relationship has been shown between the behavioral responses and type of housing since levels of adequate behavioral responses were found in individuals who lived in houses against those who lived in apartments. Additionally, the relationship between the job situation and perceived risk and anxiety, being the staff who worked full time away from home, was exposed to greater risk and anxiety. Living in a house with open spaces, such as patios and terraces, was a protective factor for mental health during the months of home confinement. While the increase in the number of working hours and the full-time shift on the front line of the pandemic were factors that favored stress and perceived anxiety.

Knowing these data from this first-line personnel will allow adopting measures that could be beneficial for stress management and, therefore, contribute to the well-being and support of these humanitarian and volunteer organizations in the worldwide response to COVID-19, in order to help people and communities to prepare and respond to the global emergency. The most important measures would be focused on increasing knowledge and official information in this population since this increases their safety and reduces their stress level. It is also important to provide volunteers with material resources and clear recommendations. Unfortunately, this pandemic has been a new situation that has overtaken many of us and many recommendations have been changing. Among the measures that have been carried out in the Red Cross Organization itself, it is worth highlighting the courses on stress management aimed at intervening personnel. These courses have therapies and coping strategies for very stressful situations. There are exercises and drills of action in extreme situations. Although there is data of high satisfaction of the volunteers participating in these courses, we plan to obtain new learning results of the therapies to volunteers in our next study.

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.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethic Committee of Red Cross Nursing

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Fear of COVID-19 and Life Satisfaction: The Role of the Health-Related Hardiness and Sense of Coherence

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Introduction: The COVID-19 pandemic is contributing to increased fear and anxiety throughout society, which may affect life satisfaction. Health-related hardiness and sense of coherence (SOC) are personal resources that help people adapt to difficult circumstances. The purpose of this study was to investigate the relationship between fear of COVID-19, SOC, health-related hardiness, and life satisfaction.

Methods: A total of 907 Polish people (522 women and 385 men) participated in this study. The Fear of COVID-19 Scale (FOC-6), the Health-Related Hardiness Scale, the Sense of Coherence Scale (SOC-29), and the Satisfaction with Life Scale were used.

Results: Correlation showed that fear of COVID-19 was negatively related to health-related hardiness, SOC, and life satisfaction. Health-related hardiness and SOC were positively related to life satisfaction. Both SOC and hardiness were mediators between fear of COVID-19 and life satisfaction during the current pandemic.

Conclusion: SOC and health-related hardiness are personal resources that are important for dealing with the effects of the COVID-19 pandemic. According to our study, SOC and hardiness can mediate between fear of COVID-19 and life satisfaction. Presented cross-sectional results have to be verified in future longitudinal studies in order to strengthen the conclusions presented in this manuscript. This study verified the role of only two personal resources, so more research is needed on the role of other personal resources during COVID-19 pandemic.

Keywords: fear of COVID-19, life satisfaction, sense of coherence, hardiness, mediation

INTRODUCTION

For over a year, the entire world has been struggling with a global pandemic caused by the spread of the SARS-CoV-2 coronavirus, which appeared in the city of Wuhan, Hubei province, China in late 2019. In early 2020, the disease caused by the virus was called COVID-19 and, on March 11, 2020, the WHO declared it a global pandemic. It is the largest pandemic to affect humans so far in the twenty first century. The clinical course of the disease varies from mild or even asymptomatic to severe respiratory failure and death. The prognosis is worse in the elderly and patients with comorbidities (1–3). According to the World Health Organization (4), more than 126 million

people in the world have been infected and more than 2.8 million have died. The first case of COVID-19 in Poland was recorded on March 4, 2020, and by March 28, 2021, almost 2.2 million people were infected and more than 51,000 have died.

COVID-19, like other contagious diseases which cause epidemics, affects not only physical health but also mental functioning. The changes in everyday life caused by the pandemic were rapid and unprecedented. COVID-19, as a global threat to public health, requires drastic control measures and has disrupted almost every aspect of everyday life. The rapid increase in confirmed cases and deaths, isolation, reduced social contact, school and workplace closures, and significant restrictions on activity and freedoms can all be stressful for society as a whole (5, 6). Even if most people are not infected and remain physically well, they often suffer from the negative psychological effects of the epidemic.

An infectious disease pandemic can also affect life satisfaction, which is an individual's cognitive evaluation of their life (7). Many previous studies have shown that experiencing difficult life situations has a negative impact on human health and well-being (8). Several studies have shown that the pandemic affects well-being and life satisfaction (6, 9–11). A Turkish study showed that fear of COVID-19 decreases life satisfaction (12), while Harper et al. (10) indicated that fear of COVID-19 reduces individuals' well-being.

A contagious disease pandemic increases fear and anxiety throughout society, as can be observed in both the current and previous epidemics (13). During the current COVID-19 pandemic, people fear becoming infected, dying or losing loved ones, and contact with people who might be infected (6, 14, 15). Fear is an adaptive protective mechanism for animals and humans that is fundamental to survival and involves several biological processes related to preparing to respond to potentially dangerous events. However, when it is chronic or disproportionate, it can cause mental disorders (16). Ahorsu et al. (17) indicated that fear of COVID-19 increases levels of psychological distress and has a negative impact on mental health. Constant information about the many fatalities around the world and the growing number of cases lead to increased fear of COVID-19, causing people to experience stress, anxiety, and mood disorders, which have a negative impact on their psychological well-being (12, 18). Coronavirus threatens one's safety and desire to survive, which affects quality of life. Therefore, fear of COVID-19 reduces people's well-being and decreases their life satisfaction (19, 20). However, Özmen et al. (19) showed that fear of COVID-19 explains only a small percentage of the variation in life satisfaction.

Hardiness is usually defined as a generalized style of functioning characterized by a high level of commitment, control, and challenge, thanks to which the negative effects of stress are mitigated. People with a high level of hardiness believe that they have control over their life and that through their commitment to their goals they will achieve positive results. They treat everyday stressors as challenges (21). The research showed that people characterized by a high level of hardiness were protected against the negative impact of stress on their life and health (22, 23).

Sense of coherence (SOC) is defined as “a global orientation that expresses the extent to which one has a pervasive, enduring though dynamic feeling of confidence that (1) the stimuli deriving from one's internal and external environments in the course of living are structured, predictable and explicable; (2) the resources are available to one to meet the demands posed by these stimuli; and (3) these demands are challenges, worthy of investment and engagement” (24).

Antonovsky (24) in his works drew attention to the relationship between SOC and hardiness. Both postulate the existence of complex personality traits that act as personal resources in stressful situations (24, 25). Also, the mechanisms by which SOC and hardiness affect physical and mental health seem to be similar (26). Therefore, many studies conducted on various populations indicate a relationship between SOC and psychological hardiness (26–28).

SOC seems to be a particularly important resource for dealing with the pandemic. Many studies have shown that high levels of SOC make it easier to accept inevitable difficulties (29, 30). Also, SOC is particularly necessary when strong stressors affect an individual (31), as in the case in the ongoing pandemic. Studies have also shown that a strong SOC is negatively associated with anxiety, perceived stress, and its consequences (32). People with a strong SOC can more effectively deal with adverse circumstances (33). SOC and hardiness are also resources that affect quality of life. The role of SOC as a significant predictor of quality of life has been demonstrated in many previous studies and analyses that found that higher SOC is linked with better quality of life (34–36). Also, hardiness can improve individuals' well-being and increase life satisfaction (37). Many studies on different populations have shown that hardiness is positively related to quality of life (28, 38) and life satisfaction (39).

Several studies conducted during the COVID-19 pandemic have shown that hardiness is a very important resource for dealing with adverse events stemming from COVID-19 (40, 41). Hardiness enables us to perform and to stay focused during hard times. It helps people to adapt to new situations and withstand adversity (21). Hardiness plays a protective role by reducing the risk of dysfunctional stress reactions occurring in emergency workers during the current COVID-19 pandemic (42). Importantly, it has also been shown that hardiness is positively related to individuals' well-being during the current pandemic (43).

In addition, many studies on different populations have shown that SOC and hardiness act as mediators in the relationships between a variety of variables (29, 30, 44–48). SOC has been found to mediate the relationship between adverse experiences and psychological well-being (29), and to mediate between symptoms, stress, coping, and life satisfaction (49). Hardiness has been found to be a mediator between stress and illness (50). Hardiness has been found to act as a mediator of the relationship between traumatic experiences and post-traumatic adaptation (51). Therefore, it can be assumed that SOC and hardiness will be mediators of the relationship between fear of COVID-19 and life satisfaction during the global pandemic.

The Present Study

The purpose of this study was to investigate the relationship between fear of COVID-19, SOC, health-related hardiness, and life satisfaction. Based on the information presented in the introduction, we decided to investigate whether: (1) fear of COVID-19 is significantly and negatively associated with SOC and hardiness; (2) SOC and hardiness are significantly and positively associated with life satisfaction; and (3) SOC and hardiness are mediators in the relationship between fear of COVID-19 and life satisfaction.

MATERIALS AND METHODS

Participants

A total of 907 Polish people (522 women and 385 men) participated in this study. The average age of all respondents was 39.28 years. Above half of the study participants had university level education. The second largest group were people with high school education. The smallest number of respondents had elementary and vocational education. About half of the studied sample represented people living in towns. The obtained number of people living in cities and villages was relatively equal. About 70% of the participants in this study were employed. We didn't verify the reasons of unemployment of the rest of the participants. The level of other sociodemographic variables has not been investigated. Detailed sociodemographic data of the studied sample were presented in **Table 1**.

Procedure

The recruitment of the study participants was carried out using the snowball method. Due to the pandemic, every effort was made to ensure that the study was completely safe for its participants. Therefore, we recruited respondents via the Internet. The recruitment of the participants took place between March and May of 2020. Study assistants were asked to share the survey on social media platforms. All people under 18 years of age were excluded from the analysis. Digitally excluded older adults were able to complete the survey by phone ($n = 11$). The study participants were informed about the anonymity of the study. They could stop filling out the survey at any time and without giving any reason. All respondents gave informed consent to participate in this study. The presented project adhered to the guidelines of the Bioethics Committee of the University of Opole.

Measures

Fear of the coronavirus was measured with the Fear of COVID-19 Scale (FOC-6) (6). Respondents answered the questions using a five-point scale (1—“definitely disagree”; 5—“completely agree”). Higher FOC-6 scores indicate higher fear of COVID-19. FOC-6 is a reliable questionnaire (Cronbach's $\alpha = 0.83$; McDonald's total $\omega = 0.84$). Confirmatory Factor Analysis indicates that the obtained model fit values are mostly acceptable ($CFI = 0.957$; $TLI = 0.928$; $RMSEA = 0.111$). After setting the error covariance between items 1 and 2 (which is theoretically justified due to the semantic similarity of those items), FOC-6 model fit coefficients improve ($CFI = 0.984$, $TLI = 0.969$, $RMSEA = 0.072$). Confirmatory Factor Analysis (CFA) results

TABLE 1 | Characteristics of the studied sample ($N = 907$).

	<i>M</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
Age				
All participants	39.28	15.30	18.00	102.00
Women	38.59	15.22	18.00	101.00
Men	40.21	15.38	18.00	102.00
		<i>N</i>	<i>%</i>	
Gender				
Women	522		57.55%	
Men	385		42.45%	
Education				
Elementary School	28		3.09%	
Vocational	65		7.17%	
High School	347		38.26%	
University	467		51.49%	
Place of Residence				
Village	220		24.26%	
Town	410		45.20%	
City	277		30.54%	
Professional Activity				
Unemployed	268		29.55%	
Employed	639		70.45%	
		<i>N</i>	<i>%</i>	
Population (15/03/2021; Polish Central Statistical Office)	38° 070 317		100%	
Studied sample (% as a part of whole Polish population)	907		<0.01%	

show acceptable model fit coefficient values for the tested 6-items one-factor model. Unfortunately, FOC-6 wasn't developed with the usage of the Exploratory Factor Analysis (EFA). Although the results of the *post-hoc* EFA based on Oblimin rotation with the usage of Maximum Likelihood extraction method confirm the results of the CFA analysis (one-factor model where all factor loadings exceed the value of 0.60), it cannot be certain that the structure would be the same as if EFA had been used during the questionnaire validation process. What is more, FOC-6 validity wasn't verified with relation to other fear of COVID-19 related scales, but it can be supported by the fact, that its results are significantly related to other similar variables, such as stress or well-being measures (6).

The Sense of Coherence Scale (SOC-29) (52), adapted by Koniarek et al. (53), was also used in this study. The questionnaire consists of 29 items related to various aspects of human life. The study participants responded to them on a seven-point scale. The questionnaire is used to study global SOC and its three components: the senses of comprehensibility, manageability, and meaningfulness. Only the global score was used in this study. The scale shows good reliability (in this study Cronbach's α was 0.91). Higher SOC-29 scores indicate higher SOC.

Hardiness was measured with the short version of the Health-Related Hardiness Scale (HRHS) by Pollock (54), in its Polish adaptation by Dymecka et al. (28). It contains 12 items that

TABLE 2 | Results of Pearson's r correlation analysis ($N = 907$).

	<i>M</i>	<i>SD</i>	<i>SKE</i>	<i>K</i>	1.	2.	3.	4.
1.Fear of COVID-19	21.41	5.84	−0.39	−0.69	–			
2.Health-related hardiness	51.76	9.14	−0.25	−0.14	−0.17***	–		
3.Sense of coherence	131.24	24.12	−0.10	0.07	−0.14***	0.41***	–	
4.Life satisfaction	22.67	5.99	−0.41	−0.25	−0.11**	0.20***	0.61***	–

** $p < 0.01$; *** $p < 0.001$; *SKE*, skewness; *K*, kurtosis.

participants assess on a six-point Likert scale, where 1 indicates complete disagreement and 6 indicates complete agreement. The scale shows good reliability (in this study Cronbach's α was 0.78). Higher HRHS scores indicate higher hardiness.

The Satisfaction with Life Scale (SWLS) (7), adapted by Juczyński (55), was also used. It consists of five questions on a seven-point scale (1— “definitely disagree”; 4— “neither agree nor disagree”; 7— “completely agree”). The scale shows good reliability (in this study Cronbach's α was 0.87). Higher SWLS scores indicate higher life satisfaction.

Statistical Analysis

In order to verify the formulated hypotheses, a number of statistical analyses were used. The significance of the relationship between fear of COVID-19, hardiness, SOC and life satisfaction was tested with Pearson's r correlation analysis. It allowed us to verify the two-sided relationships between tested variables. Before analyzing the mediational role of hardiness and SOC in the relationship between fear of COVID-19 and life satisfaction, we decided to verify if the residuals autocorrelation and multicollinearity between hardiness and SOC may have occurred. Therefore, Durbin-Watson test and Variable Inflation Factors analysis were used. One-sided relationships and indirect effects of the possible mediators were verified with mediation analysis using MODEL 4 of PROCESS v3.4 macro (56). Additionally, we decided to perform a *post-hoc* power analysis in order to check whether the obtained sample allows conclusions from the presented data. For that purpose, we used the Monte Carlo simulation (57) performed in the R environment (58). A significance level of $\alpha = 0.05$ was adopted as the threshold value for statistical significance in all analyses, which is a standard practice in the presented field of research. Bootstrapping mediation using the PROCESS macro was performed with 5,000 samples (59).

RESULTS

Correlation Analysis

In the first step of the statistical analysis, it was decided to check whether there were any significant relationships between the tested variables. In order to select an appropriate analysis, it was checked whether the distributions of the examined variables showed large asymmetry. Skewness and kurtosis statistics showed that the studied distributions did not show large asymmetry. On this basis, a parametric Pearson's r correlation analysis was performed. Pearson's r correlation showed significant

relationship between fear of COVID-19, health-related hardiness, SOC, and life satisfaction. Relationship between fear of COVID-19 and other variables was negative and weak. What is more, health-related hardiness was positively and moderately related to SOC, and life satisfaction. More detailed data are shown in **Table 2**.

Mediation Analysis

In the next step, it was decided to perform a mediation analyses due to the significant relationships found using the Pearson's r correlation analysis. Before calculating the mediation analyses, it was decided to verify if the tested residuals are correlated. Durbin-Watson test results showed, that the residuals were not correlated in the verified model. Based on the small asymmetry of the studied distributions and the lack of autocorrelation, it was decided to perform the mediation analysis as planned. Two separate MODEL 4 mediation analyses were performed, because the analysis of *Variable Inflation Factors* suggested that multicollinearity between hardiness and SOC may have occurred ($VIF > 10$).

First, it was examined whether hardiness mediates the relationship between fear of COVID-19 and life satisfaction. The second model tested whether SOC was a mediator in the relationship between fear of COVID-19 and life satisfaction. The PROCESS macro results showed that all investigated mediation paths were statistically significant. Analysis of the confidence intervals of the indirect effects suggests, that health-related hardiness and SOC mediated the relationship between stress and life satisfaction. More detailed data is shown in **Table 3**.

Power Analysis

Monte Carlo simulation (57) with 5,000 replications and 20,000 Monte Carlo draws was performed at the confidence level of 95%. The simulation confirmed the power obtained at the level of at least 0.98 for both mediation models.

DISCUSSION

This study aimed to determine the relationship between fear of COVID-19, SOC, health-related hardiness, and life satisfaction during the coronavirus pandemic. Presented results show that fear of coronavirus was negatively linked to life satisfaction of the studied sample. Our results are consistent with previous studies, which show that pandemic situation can negatively affect our life satisfaction (6, 9–11). There are multiple possible explanations of this significant result. In the COVID-19 pandemic, fear of

TABLE 3 | Detailed data of the results of the PROCESS MODEL 4 analysis ($N = 907$).

Mediator: Health-related hardiness									
Path			Symbol	Beta	b	SE	p	LLCI	ULCI
X	→	M_1	a_1	−0.17	−0.26	0.05	<0.001	−0.364	−0.163
M_1	→	Y	b_1	0.18	0.12	0.02	<0.001	0.074	0.159
X (M_1)	→	Y	c'	−0.07	−0.07	0.03	0.029	−0.140	−0.007
Indirect Effect of M_1			$a_1 * b_1$	−0.03	−0.03	0.01	–	−0.049	−0.016
Mediator: Sense of Coherence									
X	→	M_2	a_2	−0.14	−0.57	0.13	<0.001	−0.836	−0.302
M_2	→	Y	b_2	0.15	0.61	0.01	<0.001	0.138	0.164
X (M_2)	→	Y	c'	−0.02	−0.02	0.03	0.453	−0.074	0.033
Indirect Effect of M_2			$a_2 * b_2$	−0.08	−0.09	0.02	–	−0.129	−0.045
			DW	p		Autocorrelation			
Durbin-Watson test			1.94	0.358		0.03			

X, Fear of COVID-19; M_1 , Health-Related Hardiness; M_2 , Sense of Coherence; Y, Life Satisfaction; LLCI, Lower Level Confidence Interval; ULCI, Upper Level Confidence Interval; DW, Durbin-Watson' test statistic.

infection, death, and loss of loved ones are common, which leads to increased distrust of others, avoidance, and withdrawal from everyday activities (60). At the beginning of the pandemic, we all had to adapt to new living conditions, which could produce a sense of uncertainty related to the development of the epidemiological situation. An increase of anxiety during a pandemic is a natural reaction. It can cause high levels of stress, which has a negative impact on our well-being. Even though our study did not verify the role of social support, it is possible that pandemic opportunities for interpersonal contact, resulting in disruption of social support networks at the time when they may be most needed (61), because, as is known, social support is crucial for adaptive functioning (15, 62).

The current study showed also a negative correlation between fear of COVID-19 and two personal resources: health-related hardiness and SOC. In line with theoretical assumptions, the present study found a correlation between SOC and psychological hardiness. Both SOC and hardiness were mediators between fear of COVID-19 and life satisfaction during the current pandemic. According to theory, hardiness can affect perceptions of stressful events (63). In the current pandemic situation, people with high levels of hardiness may be confident that they will be able to protect themselves from infection or, in the event of infection, be able to deal with it effectively (64). It can therefore be assumed that they will cope better with the fear of COVID-19. The tension caused by a pandemic may not turn into distress and they will be less likely to experience its negative consequences, such as anxiety or depression. Thanks to this, despite difficult circumstances, they might judge their life as satisfactory. It is possible because hardy people adapt more easily to difficult life situations such as the pandemic. Also, people with high levels of hardiness become engaged in what they do, don't feel alienated, usually believe that they can at least partially control what happens to them, do not feel powerless, and treat changes as challenges and opportunities for development, rather

than as threats (65). Hardiness is related to the tendency to perceive stressful life events as less serious, less dangerous, and more manageable (21, 66).

SOC can play an equally important role in the process of dealing with the COVID-19 pandemic. SOC can, by effectively managing stress and reducing levels of anxiety, affect psychological well-being and quality of life (67, 68). In his salutogenic theory, Antonovsky (24) repeatedly emphasized the role of SOC in an individual's coping with difficult situations, because, in his opinion, SOC reduces the likelihood of strong tension turning into stress, which is extremely important during a pandemic. A person with a strong SOC sees the world as orderly and understandable, and finds order in the environment, helping them to better cope with chaotic stimuli. A strong SOC can allow a person to approach difficult situations as challenges rather than obstacles. A high SOC is also associated with an appropriate response to emotional stimuli, with low sensitivity to them and high emotional resilience. People with strong SOC seek information only when they need it to solve a problem, and not when it causes overload (24), which is particularly important during the current pandemic, as excessive focus on negative information provided in the media can lead to increased anxiety (69). In a situation where the problem cannot be solved, people with a high SOC can adapt better and thus suffer less. Another important role of SOC is to influence the emotions experienced in difficult situations. SOC may limit the experience of negative emotions in stressful situations, which is particularly important in dealing with fear of COVID-19. People with a strong SOC experience emotions consciously and they can provide a motivational basis for action (70). Therefore, the SOC's mediational role between fear of COVID-19 and life satisfaction seems theoretically justified and was empirically verified in the presented study.

The results obtained in the present study were also confirmed in previous studies. Research suggests that constant information

about confirmed deaths and the growing number of cases increased levels of fear of COVID-19, which had a negative impact on life satisfaction (12). Health-related fear, decreased availability of social support, and the curtailment of typical recreational activities have diminished well-being and life satisfaction throughout society (71). The link between the fear of COVID-19 and hardiness was also confirmed in previous studies. In Russian research, it was shown that low levels of hardiness were associated with high levels of fear of COVID-19 (72). A negative relationship between hardiness and negative emotions such as anxiety and depression has already been demonstrated in many previous studies (73–78). Studies conducted during the COVID-19 pandemic have shown that psychological hardiness is negatively correlated with anxiety, depression, and the general severity of psychopathological symptoms. Therefore, we believe that hardiness can be associated with changes in anxiety levels during the pandemic. People with lower hardiness show increased anxiety over time (71). Studies have shown that the lower the hardiness level, the greater the assessment of the negative aspects of COVID-19. For people with low levels of hardiness, the pandemic may be a source of stress that affects their quality of life (72), which is a possible explanation of the presented results.

In many studies on various populations, it has been found that SOC was negatively correlated with levels of fear, stress, and anxiety (67, 79). In previous studies, SOC was associated with lower emotional tension and lower levels of situational anxiety (70). The relationship between SOC and hardiness has also been documented in other empirical works (26–28, 80). Studies suggest that psychological hardiness is an important resource for coping with the COVID-19 threat (41). One Russian study found hardiness to be a personal adaptive resource in stressful situations related to the COVID-19 pandemic (71). We believe that people with high levels of hardiness might interpret stressful life events as being less difficult (21). Hardiness contributes to perceiving the pandemic as a challenge. High levels of hardiness can help a person control anxiety and irrational thoughts. This resource prevents unpleasant emotions and thoughts, which have a negative effect on various stress factors and secondary trauma (42).

Studies have shown that people with high hardiness have better quality of life and are more energetic and optimistic (81). In studies among elderly people, it has been shown that higher levels of psychological hardiness are associated with greater life satisfaction (39). Hardiness protects one's well-being in the face of negative life events (21). It prevents the deterioration of psychological well-being in stressful situations (71). This is why research has shown that psychological hardiness is positively related to well-being during the COVID-19 pandemic (43). This was also confirmed in our study, which showed a positive relationship between hardiness and life satisfaction during the COVID-19 pandemic.

The relationship between SOC and life satisfaction has been demonstrated in many empirical studies (82–85). Data from empirical studies confirm that SOC can affect life satisfaction, acceptance of inevitable difficulties, and sense of control of situations. Many empirical studies have confirmed

the relationship between SOC and subjective well-being, quality of life, and satisfaction with life (83). SOC helps one perceive the disease as less threatening (86). A strong SOC is particularly important when an individual experiences very difficult situations (31, 87), and the pandemic is undoubtedly one such situation. Many studies have also confirmed the role of SOC as an important mediator of the relationship between a variety of variables, including life satisfaction, as demonstrated in the present study. SOC has been shown to be a mediator between stress and life satisfaction during the COVID-19 pandemic (82). Another study found that the relationship between adversity—indicated by the occurrence of worry, anxiety, and stress—and life satisfaction can be explained by the significant mediation of SOC (29). SOC can act as a protective factor in the process of adaptation to difficult life events (49), and the mediation path found in this study can help us understand how it does so. Other study results indicate that SOC can explain more variance in many areas of quality of life than any other variable (88). Therefore, we believe that this might be a possible explanation why SOC played as a significant mediator in the relationship between fear of COVID-19 and life satisfaction.

Although our study produced important results, it is not free of limitations. Although our mediation model is tested as causal, it does not allow us to establish cause and effect relationships, since our data are cross-sectional. It would require longitudinal studies to confirm whether the proposed direction of the influence is correct. Additionally, recruiting study participants via social media is an example of convenience sampling. Such sample does not have sufficient power to detect sociodemographic group differences, which makes it limiting in the case of statistical analyses that can be used (89). Therefore, another study based on population-based sampling should be performed in order to confirm the proposed mediation model and possible group differences. Lastly, this study verified the role of fear of COVID-19 with a FOC-6 questionnaire. Although it is a reliable scale, its model fit coefficient values are acceptable at best. Additionally, FOC-6 was validated without the usage of Exploratory Factor Analysis. Next studies should be performed with a scale representing better psychometric properties, such as FCV-19S (17). FCV-19S wasn't used in the presented study due to the fact, that it started before FCV-19S was yet available. Also, the validity of FOC-6 should be verified by correlating its results with the results of the FCV-19S scale.

Previous studies have shown that SOC and health-related hardiness are personal resources that are important in the current COVID-19 pandemic. The increasing number of infections, the millions of people who have lost their lives, and the inefficiency of health care systems are leading to increased fear. Resources such as SOC and psychological hardiness can mediate the effects of fear on life satisfaction. That assumption was positively verified in the presented manuscript. Research on hardiness and SOC in COVID-19 pandemic is very important, because people with a high level of personal resources may experience greater satisfaction with life despite the duration of the pandemic. For these people, fear might be less paralyzing, and they may view

the pandemic situation as a challenge rather than a burden. Both resources facilitate dealing with difficulties by changing the way one relates and reacts to events outside one's control. The idea is not to try to change or divert attention from the problem of the pandemic, because the virus is a real threat and there are objective reasons to be afraid of it, but fear does not have to dominate one's existence. People with strong SOC and hardiness can function with realistic fears and relate to them in an adaptive manner (62). Therefore, when working with people experiencing the psychological consequences of the pandemic, it is worth considering their personal resources and to work on developing these resources.

DATA AVAILABILITY STATEMENT

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

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ETHICS STATEMENT

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

AUTHOR CONTRIBUTIONS

JD: conceptualization, project administration, writing, and original draft preparation. RG: methodology, formal analysis, writing, and original draft preparation. AM-C: conceptualization, project administration, and writing. RD and MB: conceptualization, supervision, and investigation. All authors contributed to the article and approved the submitted version.

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Public Emotional and Coping Responses to the COVID-19 Infodemic: A Review and Recommendations

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Since its onset in early 2020, the coronavirus disease 2019 (COVID-19) pandemic has adversely affected not only the physical but also the mental health of people worldwide. Healthcare professionals and laypersons have sought to learn more about this novel and highly transmissible disease to better understand its etiology, treatment, and prevention. However, information overload and misinformation related to COVID-19 have elicited considerable public anxiety and created additional health threats. Collectively, these problems have been recognized by the World Health Organization as an “infodemic.” This review provides an overview of the global challenges posed by the COVID-19 infodemic, and used the psychological entropy model as a guiding framework to explicate the potential causes of the infodemic and identify potential solutions to mitigate impacts on public health. We first examine the role of anxiety in information processing and then delineate the adverse impacts of the infodemic. Finally, we propose strategies to combat the infodemic at the public, community, and individual levels.

Keywords: anxiety, eHealth, pandemic, false information, fake news, health literacy, misinformation, coronavirus

INTRODUCTION

The coronavirus disease (COVID-19) outbreak was declared a pandemic by the World Health Organization (WHO) in March 2020 (1). Although a prominent concern is that the causal virus—SARS-CoV-2—may cause lethal damage to the respiratory system, scholars have also warned of the mental impacts of the COVID-19 pandemic on people living in affected regions [e.g., (2, 3)]. Depression and anxiety are the primary mental manifestations experienced worldwide during the COVID-19 pandemic [e.g., (4, 5)]. Many of these mental disturbances are related to the COVID-19 “infodemic,” a portmanteau of “information” and “epidemic” coined by the World Health Organization (6) to describe the overabundance of information and misinformation disseminated during the COVID-19 pandemic. Research on the mental effects of the pandemic has shown that the COVID-19 infodemic is an “invisible disaster” with serious and far-reaching deleterious impacts (7, 41). In this review, we examine mental health issues related to the COVID-19 pandemic and investigate coping responses used by the general public to deal with these effects. Specifically, we give an account of the plethora of false or misleading information widely disseminated *via* offline or online media during the pandemic and provide recommendations for tackling these timely issues.

COPING WITH UNCERTAINTY AND ANXIETY AROUSED BY THE COVID-19 PANDEMIC

The widespread uncertainty and panic that have arisen during the pandemic are attributable in part to the novelty of COVID-19, the etiology and treatment of which were unknown during the initial stages of the outbreak. According to the psychological entropy model (8), uncertainty can be modeled as entropy in one's mental state, and anxiety arises when perceived uncertainty increases. The model explicates how thoughts and feelings of uncertainty are intensified and how people attempt to mitigate such heightened levels of perceived uncertainty. The model highlights two major types of control: pragmatic and epistemic control (9). The former refers to the undertaking of immediate actions to reduce or terminate a perceived threat, and the latter refers to the active gathering of information regarding the nature, cause, and future development of the perceived threat.

The psychological entropy model is applicable to the COVID-19 pandemic because many people have been motivated to reduce their perceived uncertainty to a manageable level. In addition to passively following the COVID-19 preventive measures issued by governments and health authorities [e.g., the United States Centers for Disease Control and Prevention (CDC), WHO], one common way to enhance pragmatic and epistemic control is to search for information in an attempt to instantly mitigate the heightened anxiety, threat, and fear elicited by the pandemic. In today's digital era, the sheer volume of information flow can be emotionally taxing for information consumers (10).

INFORMATION SEEKING AS A COPING STRATEGY AND ASSOCIATED PROBLEMS

The overabundance of information and processing issues have been recognized by the WHO as the core of the "infodemic" phenomenon. In the present digital age, many people deploy information seeking as a coping strategy to mitigate heightened anxiety and gain pragmatic and epistemic control over perceived health threats and uncertainty during the COVID-19 pandemic. Such information-seeking tendencies have been exacerbated by the stay-at-home orders and restrictions implemented in many countries, such as lockdowns, curfews, and teleworking (11). People also reported expending more effort and time than usual on seeking information through the Internet when living under these measures for disease prevention (12). Although information seeking can mitigate uncertainty and anxiety, this coping strategy can also elicit psychological problems if information seekers are exposed to false and inaccurate information (i.e., misinformation), overwhelmed by information (i.e., information overload), or both.

With respect to information overload, the social media monitoring team of the Vaccine Confidence Project showed that the term "COVID-19" was mentioned more than 690 million times in digital and social media messages globally between January and May 2020 (13). As ~4.75 million COVID-19-related messages are disseminated daily, it is impossible for

Internet users to read all these messages, and thus they can only selectively view a portion of the information posted on websites. During the initial phase of the pandemic, many Internet users reported feeling confused and overwhelmed by the abundance of information available online (14).

With respect to misinformation, about half of respondents in a UK survey mentioned that they had browsed fake or inaccurate news online (15). People have posted countless pieces of false and inaccurate COVID-19 information online due to a lack of thorough understanding of the novel disease, including its etiology, transmission mode, and effective treatments (15, 16). This problem has been exacerbated by the dissemination of false and inaccurate information by renowned authoritative figures. For instance, the French Minister of Health, Olivier Véran, shared inaccurate information stating that the use of anti-inflammatory drugs (e.g., ibuprofen and cortisone) might worsen the infection. Owing to the minister's social status and reputation, some French citizens warned their social network members not to take anti-inflammatory drugs. Even if such information is not entirely false, it may not be equally applicable to every circumstance or individual (16). In a press briefing in April 2020, the US President Donald Trump suggested inaccurately that disinfectants could be used to treat COVID-19. Accidental poisoning cases related to disinfectants and bleach were found to increase in the month after the press briefing [(17), May].

During the pandemic, many people have expressed difficulties in distinguishing between true and false COVID-19 information (15). Conflicting information disseminated by government bodies and public health organizations (e.g., the CDC and WHO) has further perplexed the public that has created considerable social mistrust and complicated individuals' decision-making (13). Although some governments have communicated positive and accurate preventive information *via* telehealth to relieve the public's mental health burden during the pandemic (18), some people do not believe or are unable to digest information from official sources. Meanwhile, others continue to obtain false information from dubious online sources, despite the availability of accurate preventive information from reliable sources (19).

The COVID-19 infodemic poses considerable threats to both physical and mental health. A number of social issues have emerged, such as public fear, stigma, and discrimination toward those who are or may be infected by the disease (20). The unprecedented volume of inaccurate or false information on the disease has caused massive confusion among the general public, and has increased uncertainty and anxiety. Ironically, attempts to gain epistemic control *via* information seeking during an infodemic do not mitigate heightened anxiety levels and may even aggravate mental health problems (20).

When facing an infodemic, people may expend excessive time and energy over-interpreting information, and thus they may fail to react in a constructive manner (20). Under involuntary quarantine, loneliness and weariness are typical immediate emotional reactions. These strong unpleasant feelings can even result in undesirable consequences. One man in India committed suicide after being hospitalized for COVID-19 with an uncertain outcome [(21), May]. Another person from India committed suicide soon after learning of his infection due to worries

of infecting other villagers (22). These cases demonstrate that despite having some knowledge of COVID-19, the sources of information and how it is processed can be problematic (20).

The COVID-19 infodemic has exacerbated emotional problems among the public. A recent survey in China showed that the prevalence of depression and anxiety increased due to frequent exposure to social media (23). Another Chinese study indicated that over-exposure to pandemic-related media was a predictor of acute stress (24). Similar findings were derived from a study conducted with adults in the UK and the US (14). Specifically, respondents who more frequently sought COVID-19-related information on the Internet tended to experience higher levels of anxiety regarding COVID-19 infection. Heightened anxiety levels among this group were also related to compromised sleep quality.

The studies discussed above indicate that the COVID-19 infodemic has far-reaching consequences for mental health. Although mitigation measures have been largely effective in protecting people from COVID-19 infection and limiting the spread of this highly transmissible disease, they have also created considerable hurdles to accessing mental health services, social support, and social contacts, particularly for people in low and middle socioeconomic groups (25). Such hurdles may increase people's tendency to turn to the Internet for information. The extensive dissemination of false and misleading messages regarding the novel disease and precautionary measures has created additional challenges (26). For instance, many sources have falsely stated that boiling water, snake oil, silver, and burning incense can be used to treat COVID-19 [(27), March]. Online messages urging people to hoard protective face masks have led to unreasonable price hikes (28). Some conspiracy theorists have described COVID-19 as a bioweapon and claimed that 5G technology enables the spread of the virus [(29), January]. When COVID-19 vaccines were first rolled out, a number of conspiracy theories have also emerged, claiming that the newly developed vaccines cause COVID-19 variants, that the government put microchips in vaccines to track citizens, and that vaccines can rewrite DNA [(30), June]. These fabricated messages and conspiracy theories have intensified vaccination anxiety and hesitancy, and have reduced vaccination intention (31).

COVID-19 misinformation has prompted the public to adopt inappropriate precautionary measures and misled health professionals to prescribe treatments that deviate from the scientifically approved usage and targets of medications. For instance, hydroxychloroquine—a drug with antimicrobial immunomodulatory properties—has been wrongly touted as a cure or prophylactic for COVID-19. Some doctors prescribed the medication during the early stages of the COVID-19 pandemic because of the limited pool of available data (32). As a result, a sudden surge in demand for hydroxychloroquine has disrupted the normal supply chain and severely deprived patients who use this medication for its approved purposes.

The infodemic continues to grow, despite considerable progress in preventing and treating COVID-19 and battling the infodemic. New sources of fake, false, and inaccurate information continuously emerge in huge volumes. Although a number of vaccines have been developed and there is growing

empirical evidence demonstrates their efficacy, sources continue to disseminate false claims regarding vaccine lethality and side effects. Such false claims discourage some people from accepting COVID-19 vaccination (33). One of the most widely disseminated false claims is that vaccines can affect fertility. Since December 2020, many women have refused the COVID-19 vaccine due to their heightened fears of infertility. However, the British Fertility Society has clarified that there are no theoretical grounds or empirical evidence to show that any of the vaccines influence the fertility of women or men [(34), March].

PROPOSED APPROACHES TO COMBAT THE COVID-19 INFODEMIC

Given the numerous impacts of the infodemic on physical and mental health, developing effective methods to protect people from these effects is necessary. Scholars have estimated that the disease outbreak severity can be reduced by decreasing the amount of online misinformation by 10% or encouraging at least 20% of the population not to share fake or unverified information (35). To help combat the infodemic, we propose measures to be carried out at the public, community, and individual levels.

At the public level, social media can serve as a useful tool to tackle the infodemic, despite also being the primary route for spreading misinformation (36). Social media can contribute to controlling the infodemic in three main ways. First, public health organizations can use social media to prevent or minimize the spread of fake news and raise public awareness by disseminating reliable information and actively communicating with target groups in the community. Second, social media can serve as a tool for public health surveillance. For instance, governments can collaborate with social media companies to utilize big data analytics to unveil emerging health trends, track behavioral changes, and predict potential outbreaks. Third, social media can serve as an educational tool. Governments and public health organizations can help curb the spread of false information by teaching people how to critically evaluate the credibility and reliability of such information and encouraging them to stop sharing messages that contain questionable or unverified information.

Conflicting information provided by government bodies and public health organizations can be confusing to the public (13). Thus, governments and public health organizations should work together to develop communications regarding the prevention of COVID-19, taking advantage of the popularity of social media to disseminate consistent and reliable information. The information should be uploaded to credible websites to provide a reliable source of trustworthy information and build public trust.

Governments and social media companies are recommended to use technology-based measures to detect and control rumors. Specifically, with the advancement of artificial intelligence technology, machine learning can be used to identify misinformation on the Internet. Novel machine-learning models, such as deep neural networks, have great potential to propel the invention and development of rumor detection methods (37). Greater effort and resources should

be devoted to the development of more effective automated programs for combatting the infodemic.

“Risk communication” methods have been recommended for fighting the infodemic at the community level (35). Risk communication can bridge the gap between what experts expect people to know and what people want to know. The purpose of risk communication is to clarify uncertainties and establish trust within the community. Three key elements are crucial for achieving this goal. First, people are advised to honestly and clearly engage in self-evaluation of what they know and do not know. Second, governments and public health organizations should monitor and attend to the public anxiety that often emerges within communities during disease outbreaks. Third, governments and public health organizations should debunk myths and rumors in a proactive and timely manner to curb their viral spread in the community.

At the individual level, eHealth literacy should be cultivated among the public to facilitate the identification of reliable information sources (38). eHealth literacy and trust in reliable sources can mitigate the heightened psychological distress elicited by the infodemic and reduce the maladaptive tendency to avoid information on preventive measures. Specifically, information consumers should be made aware that it is normal to feel distressed or anxious after processing health information, but such unpleasant emotions can function to increase one’s motivation to comply with preventive measures for health maintenance (38). Information consumers who experience distress and anxiety are easily lured into believing false information that they believe is useful (38). The likelihood of adopting effective preventive measures depends largely on whether one trusts the health recommendations given by authorities. In this light, government bodies and public health organizations should collaborate to gain public trust and ensure that people voluntarily adopt the recommended preventive measures in a timely manner. Individuals who deliberately avoid information about preventive measures are less likely to comply with such measures (38). In this case, avoidance is a maladaptive strategy for coping with the infodemic. In the short term, avoidance helps individuals to avoid the expected anxiety that they associate with actively searching for COVID-19-related information (14). In the long run, individuals with eHealth literacy and access to trustworthy information sources who actively search for information will be more equipped to manage their uncertainty and foster pleasant emotions by gaining pragmatic and epistemic control.

In addition to eHealth literacy, general critical health literacy is essential for mitigating the adverse effects associated with the infodemic (39). In particular, public health authorities should formulate policies to help cultivate public health literacy, such as maintaining trustworthy health information sources that

are convenient to access and easy to understand. Combating the infodemic requires a joint effort from public health authorities and the public. If government bodies and public health authorities take responsibility for proactively creating trustworthy information sources and building health literacy among the public, information consumers may choose to trust the health information provided by these authorities. As a result, the adverse impacts of the infodemic can be minimized.

The recommended measures for combating the infodemic among the general public are equally applicable to healthcare professionals. Findings have indicated that healthcare professionals tend to perform no better than laypersons in detecting false health-related news or reports (40). Healthcare professionals are advised to be critical when making health decisions, be sensitive to the credibility of information sources, and perform fact-checks when confronted with information disseminated through questionable sources (12).

In conclusion, the present review seeks to raise public awareness of the COVID-19 infodemic, highlight its adverse impacts, and offer recommendations for addressing these problems at the public, community, and individual levels. During the COVID-19 pandemic, the infodemic has had an immense detrimental impact on the physical and mental health of people worldwide. Although the infodemic is a novel phenomenon, its present and imminent adverse consequences should not be ignored, and immediate action is needed. Governments, public health organizations, and the public should cooperate to combat the COVID-19 infodemic.

AUTHOR CONTRIBUTIONS

WY and CC contributed to literature review and wrote the first draft of the manuscript. CC obtained funding and supervised the project. All authors have reviewed and approved the final version of the manuscript for publication.

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Adherence and Psychosocial Well-Being During Pandemic-Associated Pre-deployment Quarantine

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Background: With the purpose of preventing SARS-Cov-2 traveling with the troops, pre-deployment and post-deployment quarantine are mandatory for the German military. This study investigates which factors could be addressed in order to facilitate adherence and mental health during isolation.

Method: Six hundred three soldiers completed questionnaires at the beginning and at the end of pre-deployment quarantine: Mini-SCL (BSI), Perceived Social Support (FSozU-K22), Unit Cohesion, Military Quarantine Adherence Questionnaire (MQAQ), and quarantine-associated factors including informedness about Covid-19, perceived individual risk, benefit of quarantine, clarity of quarantine protocol, need of intimacy, social norms, stigma, practicality of the quarantine, financial disadvantages, boredom, and health promoting leadership.

Results: Using stepwise regression analyses, up to 57% of the quarantine adherence was explained by social norms, boredom, perceived benefit/effectiveness of the quarantine, clear communication of the quarantine protocol and perceived risk of an infection, with social norms explaining 43%. In respect to mental health (Mini-SCL) at the beginning of quarantine, only 15% is explained by being in a partnership, (un)fulfilled need for bonding/intimacy, perceived unit cohesion, and perceived social support. Up to 20 % of the variance in mental health at the end of quarantine is explained by accumulated days of isolation before pre-deployment quarantine, age, clear communication of the quarantine protocol, perceived social support, fulfilled need for bonding/intimacy and perceived stigma. Mental health and quarantine adherence did correlate significantly, but to a slight extent. No differences between the beginning and the end of pre-deployment quarantine were found for the overall group in respect to mental health, quarantine adherence, perceived social support and perceived unit cohesion, while their trajectories differed for different subgroups including age, gender, rank, and accumulated days of quarantine: With increasing accumulated days of isolation prior to pre-deployment quarantine, mental health declined over the course of quarantine, though to a small degree.

Conclusion: Findings suggest that addressing the norms of fellow soldiers and dependents alike could contribute to quarantine adherence in pre-deployment

quarantine. Ongoing research should examine long-term effects on mental health, including these of accumulated days of quarantine, also taking into account post-deployment quarantine.

Keywords: quarantine, psychosocial impact, mental health, military, deployment, adherence—compliance, Covid-19

INTRODUCTION

While around 17 million soldiers lost their lives in the First World War between 1914 and 1918 (1), at least 20–50 million people succumbed to the Spanish flu between 1918 and 1920 (2), according to individual estimates up to 100 million people (3) – with a world population of 1.8 billion. Nonetheless, it is reported (4) that in the Franco-Prussian War of 1870/71 and in World War I (WWI), for the first time, more soldiers were killed in combat than by infectious diseases, especially on the German side (4). The first-time low death-toll caused by infections is explained by sanitary and hygienic measures as well as the military ordering of vaccinations (4). However, troop movements also spread infectious diseases during WWI. Along with other factors, the spread of the “Spanish” flu is attributed to a transport of US troops (4, 5). Summing up, the armed forces have historically played a pioneering role in fighting epidemics and pandemics as well as in its spread and globalization.

During the current Coronavirus Disease 19 (Covid-19) pandemic, troops continue to be deployed worldwide, while the civilian population is called upon to stay at home, e.g. by the Federal German Ministry of health (<https://www.zusammengegencorona.de/wirbleibenzuhaus/>). Departments of Defense across the globe have issued force-specific health protection guidance for deployment and redeployment of individuals and units during the Covid-19 pandemic in 2020 (6, 7). Their purpose is to maintain the health and operational readiness of their own and allied troops as well as protecting the vulnerable population in the regions (countries) of deployment and their own population at home upon return of the troops. In addition to hygiene measures, soldiers have been ordered to quarantine 14 days prior to deployment and upon return home (7–9). Differing from quarantine and isolation measures for the civilian population, it is applied to soldiers with no previous contact with an infected person or a confirmed infection.

Containment of infections in the context of the current Covid-19 pandemic is only considered to be attainable, if people adhere to the quarantine or isolation rules. The effectiveness of early quarantine measures for reducing incidence and mortality is supported by a rapid review (10). Therefore, we are interested in quarantine adherence with this specific group and factors impacting on the adherence.

As the Parliamentary Commissioner of the German Bundeswehr (11) received several complaints concerning the hardships of pre-deployment quarantine, we are interested in finding out, if the deployment-related quarantine(s) have an impact on mental health and which quarantine-related factors potentially influence the mental health of the quarantined military personnel.

Attitudes of Military Personnel Toward Post-deployment Quarantine and Mental Health

There is a dearth of research on military deployment-related quarantine. An exception is a cross-sectional study reporting on a 3-week collective post-deployment quarantine after a humanitarian logistic mission to Ebola-affected West-Africa in 2014 (12). The percentage of soldiers reporting significant symptoms of a mental health disorder (3.2%) at the end of a collective post-deployment quarantine (12), seems considerably low when comparing these to 2.4% pre-deployment and 5.8% during deployment on a humanitarian mission during the Ebola pandemic in Liberia in a different study (13) or to prevalence rates for deployment-related disorders with high combat-exposure in Iraq and Afghanistan, e.g., for PTSD 9–20% (14). However, reported sleeping problems, often a precursor for mental health problems, are considerably higher with 29.8% (12) as compared to 4.9% before and 12.4% during deployment to Liberia during the Ebola pandemic (13).

Factors associated with sleeping quality and a positive attitude toward the quarantine quality were perceived family support and health promoting leadership.

The low impact of post-deployment quarantine on mental health and positive attitude toward the quarantine seem to contrast with the results of many studies on mental health of civilians quarantined and their quarantine adherence (15, 16). Therefore, the factors singled out to influence civilians’ quarantine adherence and civilians’ mental health should be described in more detail, as at this point the results on post-deployment quarantine (12) cannot be generalized to the current Covid-19 pandemic for the following reasons: 1) the relative objective risk of infections changing between countries throughout the Covid-19 pandemic, often implying higher infection rates in the soldiers’ home countries than during deployment, by contrast with a zero infection with Ebola domestically in 2014, 2) the additional pre-deployment quarantine, 3) the extent of physical isolation during individualized quarantine as opposed to collective confinement involving regular training (12), 4) the purpose of the foreign assignment, a potential combat mission vs. humanitarian support in an epidemic [Ebola, 2014], and 5) the voluntariness of the mission and related quarantine.

It can be assumed that these factors influence the attitudes and management of the quarantine situation as well as the protective factors of perceived social support, perceived military leadership and unit cohesion.

No relevant studies were found on how quarantine or isolation measures affect the protective factors of social support and

unit cohesion for military personnel, when we used the search terms “unit cohesion and quarantine” and “unit cohesion and isolation” in the data bases ERIC, APA Psynindex, APA Psych Articles, PsycInfo, Medline, SCOPUS, and PubMed for articles up to 20/08/2021.

Rates of Adherence With the Quarantine or Isolation Protocol and Factors Influencing Adherence

Internationally, adherence rates of the civilian population with the quarantine protocol vary between 0 and 92.8%, differing between people, groups of people and the occasion (16). These numbers are based on 14 studies between 2004 and 2018 in the context of various pandemics such as SARS, MERS and H1N1 influenza (16). To our knowledge, in Germany there are no statistics available on quarantine adherence of the German population in the current Covid-19 pandemic.

As to the questions which sociodemographic factors influence quarantine adherence positively, female gender (17, 18) and higher age (17, 19, 20) have been identified. Results for higher education are mixed (19, 21, 22). Mitigating factors could be the place of quarantine (19), individual or collective quarantine (22, 23).

While the knowledge about relevant sociodemographic factors indicates which groups should be addressed for improving adherence with the quarantine protocol, the question remains how to do so respective which psychological factors facilitate adherence.

Main factors found are knowledge respective clear information about the disease and quarantine procedure (24, 25), respective health literacy (23, 26), social norms in favor of quarantine adherence (or even social pressure) (16), perceived risk of the disease and perceived benefits of quarantine (16) as well as the practicability of the quarantine, including sufficient supply with food and necessary daily goods, and access to medical treatment, as well as financial security (16, 24, 27) and level of psychological distress (16, 23). Single studies indicate that the endorsement of ethical principles, including “citizen’s duty,” “community mindedness,” and the “greater good” based on free will, could facilitate adherence (28–31). The threat of enforcement was found to have less an effect than the credibility of compliance-monitoring” (30).

Impact of Quarantine on Mental Health

Rapid reviews (15, 32) and one meta-analysis (33) on the mental health impact of quarantine conclude that there is (“compelling”) “evidence for adverse mental health” effects, including anxiety and depressive disorders and stress-related disorders. However, most of the studies these reviews are based on are cross-sectional in nature. When comparing systematic reviews on pandemic lockdowns and home-confinement, we found that the three reviews which included cross-sectional studies and studies without control groups (34–36) found strong mental health effects, while a meta-analysis of exclusively longitudinal studies found small effects for mental health and concluded that most people were psychologically resilient to home confinement

and lockdowns (37). To our knowledge, no meta-analyses are available analyzing the effect of quarantine on mental health including longitudinal or even prospective studies only. Therefore, we cannot rule out that effect sizes would decline when more methodological rigor is applied.

The systematic review (33) and the two rapid reviews (15, 32) describe sociodemographic and quarantine-related factors shaping the impact of the quarantine on mental health.

Single studies report sociodemographic factors constituting a higher vulnerability for certain groups, including younger age (38–40), lower levels of education, more severe financial consequences (38, 41–45), a history of previous mental illness and perceived physical health problems (33). However, exceptions are found for specific mental disorders, as alcohol abuse was found to be more prevalent with a higher economic status (46) and depressive disorders above the age of 55 (43).

Quarantine-related risk factors are previous exposure to infection and perceived risk of the infection, the duration of quarantine (15, 32, 33), dissatisfaction with the containment measures, in particular lacking provision with food, necessary supply and medical availability (15, 33), quarantine-related stigmatization (24, 47, 48) and lacking perceived social support (33, 45, 49, 50).

In the case of pre- and post-deployment quarantine, it is not only the quarantine which can impact on mental health but also the deployment itself resulting in an accumulation of stress factors.

Military Deployment and Mental Health

Reported prevalence and incidence rates of deployment-related mental disorders vary between countries deploying soldiers and region of deployment, the methodologic rigor of the respective study and the procedure used for assigning a mental health disorder, based on a clinical interview vs. based on self-report questionnaires. For instance, prevalence of PTSD is higher for Iraq (12.9%; 95% CI 11.3% to 14.4%) than Afghanistan (7.1%; 95% CI 4.6% to 9.6%) (14). There is growing evidence that it is not deployment per-se affecting mental health, but combat during deployment (14, 51). This tendency is supported for the German Armed Forces: While the prevalence of mental disorders in Bundeswehr soldiers is generally lower than in a comparable civilian population (14.4 vs. 20%), the prevalence of panic disorders / agoraphobia and post-traumatic stress disorder is more common in soldiers with combat experience in foreign deployments than in the civilian population (52). The military-specific variant of social support “unit cohesion” has been shown in a large number of studies to be protective for mental health (53–56) and perceived social support in general (57). Here, again, we do not know how perceived social support in general and how unit cohesion in particular is affected by pre-deployment quarantine.

Pre-deployment Quarantine During the Covid-19 Pandemic

Many of the factors, here described as being associated with quarantine adherence and quarantine-related mental health, were addressed in a standardized way during the pre-deployment

quarantine of the German troops, thereby offering an (almost) quasi-experimental design: Soldiers are informed that the pre-deployment quarantine (“Isolierte Unterbringung”) is officially ordered on the instructions of the Ministry of Defense. They are briefed on the purpose of the quarantine and the quarantine protocol pre-quarantine and when in-processing in the quarantine facilities. Quarantenees are tested for the SARS-Cov-2 virus when in-processing into the quarantine and when out-processing. Concerning the practicality, quarantenees are provided with full-board in a hotel. They can order necessary daily goods and niceties online. A military organizational team in the hotel can be contacted 24/7. When necessary, medical care is provided for by a military GP. In addition, the phone number of a psychologist is offered. During pre-deployment quarantine, military personnel receive their regular salaries. In addition, they are compensated financially or by compensatory time-off for duty-related confinement 24/7. Violations of the quarantine-protocol are quite likely to be detected, investigated and result in disciplinary measures making them less likely. Prior to deployment, the health status of deploying soldiers must be screened.

Depending on assessed pandemic risk, immunization status, requirements by country of deployment, allied forces and international organizations, the required length of quarantined has been changed several times in 2021 (6, 58). Unlike the civilian population, quarantining and testing are mandatory for inoculated military personnel before (re)deployment.

Summing up, there is multiple evidence in favor and against pre-deployment quarantine affecting mental health and conditions of pre-deployment quarantine facilitating or obstructing quarantine adherence. So far, we also do not know how pre-deployment quarantine affects the health protective factors of perceived unit cohesion and perceived social support.

As a consequence of the current state of research, we are interested in the following questions:

- 1) Does pre-deployment quarantine affect the quarantenees' mental health, respectively does their mental health change over the course of pre-deployment quarantine?
- 2) Does quarantine adherence change over the course of quarantine?
- 3) Does pre-deployment quarantine affect perceived social support and perceived unit cohesion, respectively do they change over the course of pre-deployment quarantine?

Based on previous research (12, 15, 16, 33), we expect the following relationships between mental health and quarantine adherence on the one hand and presumed mental health and adherence facilitating factors on the other hand:

Hypothesis 1: Mental health predicts quarantine adherence.

Hypothesis 2: Mental health (Mini-SCL) is positively influenced by:

- Fewer accumulated days of quarantining,
- low perceived risk of infection,
- the perceived level of information about Covid-19,
- the perceived benefit of the quarantine,
- the perceived level of clarity regarding the quarantine protocol (purpose, duration, rules regarding isolation),

- low perceived costs including: a high perceived practicability of the quarantine (being well provided for during the quarantine) low stigmatization,
- compliance with social norms supporting quarantine adherence,
- a low level of boredom
- the level of perceived social support in general and military and quarantine-specific forms of perceived social support in particular:
 - unit cohesion and healthy leadership behavior and
 - fulfilled need for bonding/intimacy.

Hypothesis 3: Quarantine adherence is positively influenced by:

- fewer accumulated days of quarantining,
- a higher perceived risk of infection,
- the perceived level of information about Covid-19,
- health-promoting leadership behavior,
- the perceived benefit of the quarantine, foremost its preventative effectiveness,
- the perceived level of clarity regarding the quarantine protocol (purpose, duration, rules),
- low perceived costs including: a high perceived practicability of the quarantine (being well provided for during the quarantine)
- low stigmatization,
- compliance with social norms supporting quarantine adherence,
- a low level of boredom,
- fulfilled need for bonding/intimacy and
- the absence of financial disadvantages.

METHODOLOGY

Participants and Procedure

Data were collected during pre-deployment quarantine between February and July 2021. Administered informed consent had to be adapted to the quarantine protocol. PowerPoint presentations informed about the study as part of the inprocessing at the quarantine facility when soldiers were instructed about the quarantine protocol. In addition, soldiers interested in participating were informed by writing and provided phone numbers they could contact for further questions. Participants were enrolled in the study upon prior written consent.

Measures

As this study forms part of a longitudinal design with up to five measurement points, the rationale for choosing assessment instruments was to reduce dropout by keeping completion time as short as possible while at the same time relying on reliable and valid measures, when available.

Mental Health

The Mini-SCL, the German version of the Brief Symptom Inventory, measures psychological distress (mental strain) during the last 7 days, thereby covering a relevant time period for the purpose of measuring short- and long-term effects of quarantine. The GSI-score of the Mini-SCL shows good convergent and

discriminant validity and very high reliability ($\alpha \geq 0.90$), while still being sensitive to change (59). It takes 1–2 min to complete the questionnaire. In addition, it provides norms for a broad range of age groups.

Military Quarantine Adherence Questionnaire (MQAQ)

As to our knowledge, no instrument was available measuring military quarantine adherence, we developed an eight-item scale, the “Military Quarantine Adherence Questionnaire (MQAQ).” The MQAQ is based on one of the scales assessing medication adherence we considered most adequate, the *Medication Adherence Report Scale* of Horne (60) assessing the attitude toward the pre-deployment quarantine and quarantine protocol, struggling with the protocol on a daily basis and motivation to adhere on a daily basis. Based on the PCA with Varimax rotation, two components have been extracted, “attitude toward the quarantine protocol” and the “frequency of struggling with adhering to the protocol.” As only, the eight-item scale reached good internal consistency ($\alpha = 0.8$), it is recommended to use one scale only (61).

Perceived Social Support

Perceived social support is measured by a short version (K-22) of the FSzU (62). While contentwise, the items allow to use subscales for different forms of perceived social support, including practical support, emotional support, social integration, trusted person and satisfaction with social support, it is recommended to use the short version K-22 as one scale (63–65). Reliability (Cronbach Alpha) is excellent with $\alpha = 0.91$. Its criterion validity, including its convergent and discriminant validity (64), is good. Norms for clinical and non-clinical groups are available. Answering the questions of FSzU-K-22 takes 5 min.

Perceived Unit Cohesion, Health Promoting Leadership, Need for Intimacy/Bonding

Prior to the study, scales measuring perceived unit cohesion and perceived health promoting leadership have not been validated in German language. These two five-point Likert-scales have been validated with a separate sample ($n = 148$) (61). Health promoting leadership is a six-item scale capturing two components, (a) if the respective soldier believes his/her military leaders to be concerned about her/his physical and mental health (individual health promoting leadership) and (b) the degree to which military leaders focus on preventing infections with the Coronavirus (Covid-specific leadership). Perceived unit cohesion is rated on seven items describing the relationship with the soldier's military peers and military leaders. Exploratory PCA with varimax rotation yielded a three component structure, explaining 71.9% of the variance: (a) unit cohesion, (b) individual health promoting leadership, and (c) Covid-specific leadership. Internal consistencies range between good and excellent for the four subscales “perceived support by military supervisor” ($\alpha = 0.88$), “perceived support by military peers” ($\alpha = 0.85$), individual health promoting leadership ($\alpha = 0.90$), and Covid-specific leadership ($\alpha = 0.87$) and the two main scales, health promoting leadership ($\alpha = 0.89$) and unit cohesion ($\alpha = 0.90$). Criterion

validity is supported by moderate positive correlations between the military specific scales “unit cohesion” and “health promoting leadership” ($r = 0.36$, $p < 0.001$, $n = 138$) and perceived social support (FSzU-K-22) correlating positively with unit cohesion ($r = 0.28$, $p < 0.001$, $n = 138$) and military-specific health promoting leadership ($r = 0.19$, $p < 0.001$, $n = 138$), though to a small degree (61).

Quarantine-Related Factors With Potential Impact on Mental Health and Adherence

In the absence of a validated scale capturing nine quarantine-related psychosocial factors potentially facilitating mental health and quarantine adherence, we assessed its psychometric properties with a separate sample of 152 soldiers quarantined. Subjecting 37 items to principal component analysis using nine components as a cut-off criterion and varimax rotation, seven of the nine conceptualized factors were extracted, explaining 59.23% of the variance: With one exception, the scales yielded satisfactory to good reliability (consistency). The factors respective scales are: (1) the four-item scale “Perceived knowledge about Covid” ($\alpha = 0.83$), (2) the seven-item scale “Perceived benefit of the quarantine” ($\alpha = 0.83$), (3) the five-item scale “Perceived risk of infection” ($\alpha = 0.74$), perceived risk of infection (oneself, peers, relatives) ($\alpha = 0.85$), (4) the six-item scale “Perceived practicality of the quarantine” (supply with food, medical care, information, loved ones is cared for) ($\alpha = 0.82$), (5) the five-item scale “positive social norms toward the quarantine by relevant others” [short: social norms] (military peers and family) ($\alpha = 0.73$), (6) the five-item scale “perceived stigmatization” (by fellow soldiers/peers) ($\alpha = 0.73$), (7) the five-item scale “boredom” ($\alpha = 0.87$), (8) the seven-item scale “Perceived clarity of communication concerning the quarantine protocol” (purpose, duration, rules relating to isolation) reaches acceptable consistency when the items are standardized ($\alpha = 0.75$), and (9) the four-item scale “Fulfilled need for intimacy/bonding” ($\alpha = 0.59$), including the aspects of intimacy, physical closeness and sexuality, and aspects of bonding, including contact to relevant others and holidays with relevant others.

The scale “clear communication of the quarantine protocol” reaches satisfactory reliability ($\alpha \geq 0.7$), when all items are standardized. Therefore, all items are z-standardized before calculating scale means.

Financial Disadvantage Due to the Quarantine

This aspect was captured by one item “Due to the quarantine, I am/my family is experiencing financial disadvantages (e.g., additional costs for child care, shortened deployment¹, etc.).”

Analysis

All analyses were carried out in SPSS 25. Required sample size was calculated with the help of GPower (66). When not available in SPSS 25, effect sizes and confidence intervals (CIs) were calculated manually with the help of the two websites, <https://www.psychometrica.de/korrelation.html> for correlations

¹ When the deployment period is shortened, compensatory payment, linked to days deployed, is reduced as well.

(67) and <https://effect-size-calculator.herokuapp.com/> for partial eta squared (68) and omega squared (69).

Sample

Required Sample Size

A sample size of 361 participants provides sufficient power for detecting changes between the beginning and the end of quarantine in respect to quarantine adherence, mental health, perceived social support, and unit cohesion (F -tests—ANOVA: Repeated measures, within factors, effect size $f = 0.1$, α err prob = 0.0125, power ($1-\beta$ err prob) = 0.90, number of groups = 1, number of measurements = 2, corr among rep measures = 0.5) (66, 70).

Hypothesis 1, 2, and 3 were tested independently of each other. As these hypotheses are directed, the initial error probability is $\alpha = 0.1$. With the objective of testing hypotheses 1, three correlations were calculated, and for testing hypothesis 2 and 3, three linear multiple stepwise regressions were carried out, respectively. The error probability was adjusted accordingly at $\alpha = 0.03$. The a priori computed required sample size is 352 (F -tests—Linear multiple regression: Fixed model, R^2 deviation from zero, effect size $f^2 = 0.10$, α err prob = 0.03, power ($1-\beta$ err prob) = 0.90) (66).

The Sample and Accounting for Potential Bias

Six hundred three soldiers in pre-deployment quarantine participated in the study. Due to missing sociodemographic data, the sample size could be reduced to $n = 470$. The minimal sample size still constituted over-recruitment: For most of the sociodemographic variables, missing data remained less than $n = 10$ (1.69%) for each of the variables included and was not correlated with any of the variables resulting in no potential bias. The largest percentage of data exclusion can be attributed to lacking information on accumulated days of quarantine, 7.26% ($n = 43$).

Sociodemographics

Participants were between 18 and 64 years old with a mean age of 35 years ($SD = 8.5$ years). 88.2% were male and 10.6 female. 12.6% had a lower rank (enlisted personnel/private/corporal), 51.7% a middle rank (non-commissioned officers), and 31.7% had a higher rank (commissioned officer). 55.1% served as regular service members (under a limited contract) and 36.2% served as professional servicemembers (under an unlimited contract). Temporarily enlisted soldiers constituted 0.9% and reserve soldiers 4%.

78.8% were in a partnership and 19.4% were single. Soldiers with and without children (49.1%, respectively) were fairly distributed. 2.2% of all participants in the study were single caretakers, making up 4.4% of all caretakers. During the pandemic, a fourth of all caretakers (25.2%) had to leave their kids with the pandemic-specific emergency care.

Number of previous deployments ranged between 0 and 40 times (resulting in 1,500 days in theater) with a median of 2.38. 28.9% have not been deployed before, 21.6% once, 14.4% twice, 9.8% three times and 7.3% at least four times. The median for

cumulative days of deployment was 217.5 days; the maximum was 1,680 days in theater.

67.5% reported having been ordered to quarantine before the pre-deployment quarantine: 48.6% once, 13.4% twice and 3.3% three times and 1.3% at least four times. The maximum number of previous days in quarantine reported was 307 days with a median of 9.32 days in a previous quarantine. 1.4% reported having been quarantined more than 50 days prior to the pre-deployment quarantine. Numbers of days in quarantine does not only refer to pre-deployment quarantine, but refers to all forms of quarantining prior to the pre-deployment quarantine. Though, a sum of 307 days in quarantine raises questions. Excluding data might cause biased results as well as including an extreme potentially unreliable case. Therefore, we carried out the statistics with all cases included and controlled for a potential bias by carrying out the same calculation after this case had been eliminated. Only deviating results will be reported for the sake of readability.

RESULTS

Changes of Mental Health, Quarantine Adherence, Perceived Social Support, and Unit Cohesion Over the Course of Pre-deployment Quarantine

Four one-way repeated measures ANOVAs were conducted with the dependent variables mental health (MINI-SCL), quarantine adherence, perceived social support, and perceived unit cohesion. The following innersubject factors were entered: age, gender, partnership, number of children, single caretaker, children in pandemic emergency care, rank, accumulated days of deployment, and accumulated days of quarantine at the beginning of quarantine.

Using Pillai's trace, the ANOVAs yielded no significant differences between the beginning and the end of quarantine for quarantine adherence, $V = 0.000$, $F_{(1,466)} = 0.045$, $p = 0.832$, $\eta^2 = 0.000$, LL CI_{97.5%} = 0, UL CI_{97.5%} = 0.011, $\omega^2 = 0$, mental health (Mini-SCL), $V = 0.000$, $F_{(1,462)} = 0.016$, $p = 0.900$, $\eta^2 = 0.000$, LL CI_{97.5%} = 0, UL CI_{97.5%} = 0.008, $\omega^2 = 0$, perceived social support, $V = 0.008$, $F_{(1,462)} = 3.796$, $p = 0.052$, $\eta^2 = 0.008$, LL CI_{97.5%} = 0, UL CI_{97.5%} = 0.037, $\omega^2 = 0.006$, and perceived unit cohesion, $V = 0.000$, $F_{(1,447)} = 0.205$, $p = 0.651$, $\eta^2 = 0.000$, LL CI_{97.5%} = 0, UL CI_{97.5%} = 0.016, $\omega^2 = 0$.

"Accumulated days of quarantining prior to pre-deployment quarantine" was the only covariate (sociodemographic variable) influencing mental health over the course of pre-deployment quarantine [$V = 0.02$, $F_{(1,462)} = 8.313$, $p = 0.004$, $\eta^2 = 0.018$, LL CI_{97.5%} = 0.001, UL CI_{97.5%} = 0.054, $\omega^2 = 0.016$], predicting a slight decline of mental health over the course of quarantine (see **Figure 1**). After excluding the extreme case with reportedly 307 days in quarantine, the effect became more pronounced [$V = 0.04$, $F_{(1,461)} = 19.391$, $p = 0.000$, $\eta^2 = 0.04$, LL CI_{97.5%} = 0.010, UL CI_{97.5%} = 0.088, $\omega^2 = 0.038$].

As the figure for plotting mental health curves depending on accumulated days of quarantine and moment during quarantine is confusing, we transformed accumulated days of

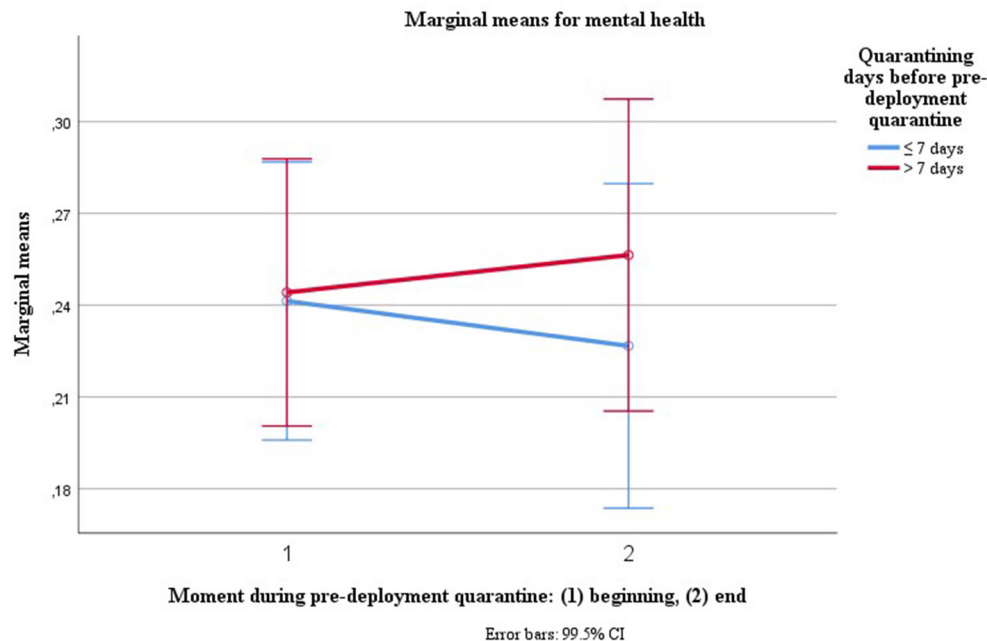


FIGURE 1 | Trajectories for mental health dependent on previous quarantining.

prior quarantining into a dichotomous variable, using cut-offs of typical quarantining periods, here 1–4 weeks of prior quarantining. The effect is stable for all cut-offs. Here, **Figure 1** is illustrating the effect using a cut-off of 1 weeks of prior quarantining or isolation before pre-deployment quarantine.

Gender [$V = 0.016$, $F_{(1,466)} = 7.765$, $p = 0.006$, $\eta^2 = 0.016$, LL $CI_{97.5\%} = 0.001$, UL $CI_{97.5\%} = 0.051$, $\omega^2 = 0.014$] was the only innersubject factor to predict changes in quarantine adherence, predicting a decline in adherence over time and adherence remaining constant for male gender (see **Figure 2**).

As we understand gender as a proxy variable, we explored *post-hoc* which psychosocial factors, assessed at the beginning of quarantine, could explain the decline in adherence for female gender. The only variable correlating negatively with quarantine adherence ($r = -0.14$, $n = 590$, $p < 0.000$, t_2 : $R = -0.23$, $p < 0.001$, $n = 590$) and correlating positively with gender, though non-significantly (t_1 : $R.043$, $p = 1.1$, $n = 587$, t_2 : $r = 0.07$, $p = 0.02$, $n = 584$), was mental health symptoms (Mini-SCL). When adding the variable “mental health symptoms at the beginning of the quarantine” as a between-subject factor into the Repeated Measures ANOVA [$V = 0.68$, $F_{(1,204)} = 1.55$, $p = 0.001$, $\eta^2 = 0.68$ LL $CI_{97.5\%} = 0.08$, UL $CI_{97.5\%} = 0.37$, $\omega^2 = 0.24$], then the gender effect disappeared [$V = 0.011$, $F_{(1,204)} = 2.17$, $p = 0.146$, $\eta^2 = 0.01$ LL $CI_{97.5\%} = 0.00$, UL $CI_{97.5\%} = 0.06$, $\omega^2 = 0.01$].

For perceived social support, two of the inner subject factors, age [$V = 0.018$, $F_{(1,462)} = 8.534$, $p = 0.004$, $\eta^2 = 0.018$, LL $CI_{97.5\%} = 0.001$, UL $CI_{97.5\%} = 0.054$, $\omega^2 = 0.016$] and accumulated days of quarantines at the beginning of quarantine [$V = 0.036$, $F_{(1,462)} = 17.381$, $p = 0.000$, $\eta^2 = 0.036$, LL $CI_{97.5\%} = 0.008$, UL $CI_{97.5\%} = 0.082$, $\omega^2 = 0.034$], predicted a decrease in perceived social support over the course of pre-deployment quarantine

(see **Figure 3**). When the extreme case with reportedly 307 days in quarantine is eliminated, the tendency of accumulated days of quarantine pre-quarantine remains, but is not significant anymore with Bonferroni-correction [$V = 0.012$, $F_{(1,461)} = 5.819$, $p = 0.016$, $\eta^2 = 0.012$, LL $CI_{97.5\%} = 0$, UL $CI_{97.5\%} = 0.045$, $\omega^2 = 0.010$].

The only innersubject factor predicting change in perceived unit cohesion over the course of quarantine was rank [$V = 0.020$, $F_{(1,447)} = 9.262$, $p = 0.002$, $\eta^2 = 0.020$, LL $CI_{97.5\%} = 0.001$, UL $CI_{97.5\%} = 0.058$, $\omega^2 = 0.018$], with lower ranks’ (enlisted personnel’s) adherence increasing over time, middle ranks’ (non-commissioned officers’) decreasing and higher ranks’ (commissioned officers’) remaining constant (see **Figure 4**).

Predicting Mental Health and Adherence During Pre-deployment Quarantine

Hypothesis 1: Mental Health Predicts Quarantine Adherence

Mental health at the beginning of quarantine (Mini-SCL) and adherence at the end of quarantine are significantly related ($r = -0.16$, $p < 0.001$, $n = 586$, Fisher’s $z = -0.16$, LL $CI_{90\%} = -0.23$, UL $CI_{90\%} = -0.09$). Mental health and quarantine adherence at the end of quarantine are significantly related ($r = -0.30$, $p < 0.001$, $n = 588$, Fisher’s $z = -0.31$, LL $CI_{90\%} = -0.36$, UL $CI_{90\%} = -0.24$).

Hypothesis 2 and 3

Multiple stepwise regressions were calculated in order to predict mental health and quarantine adherence at different moments during the pre-deployment quarantine based on nine

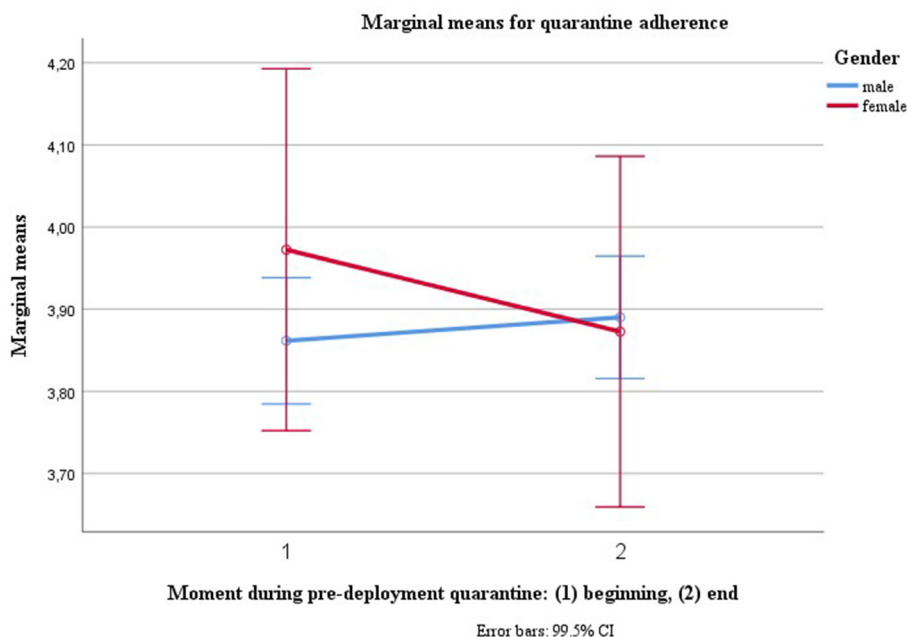


FIGURE 2 | Trajectories for quarantine adherence for male and female soldiers.

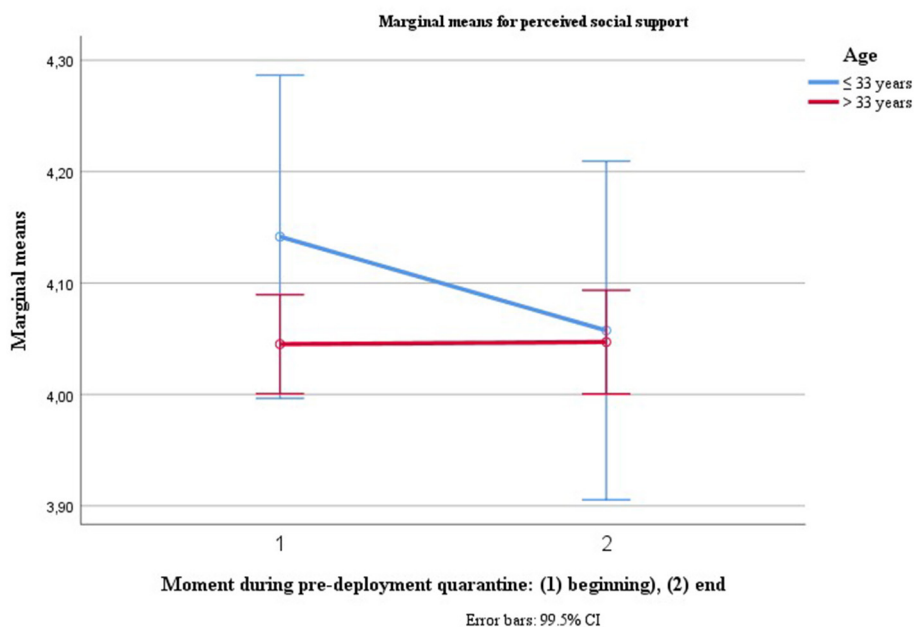
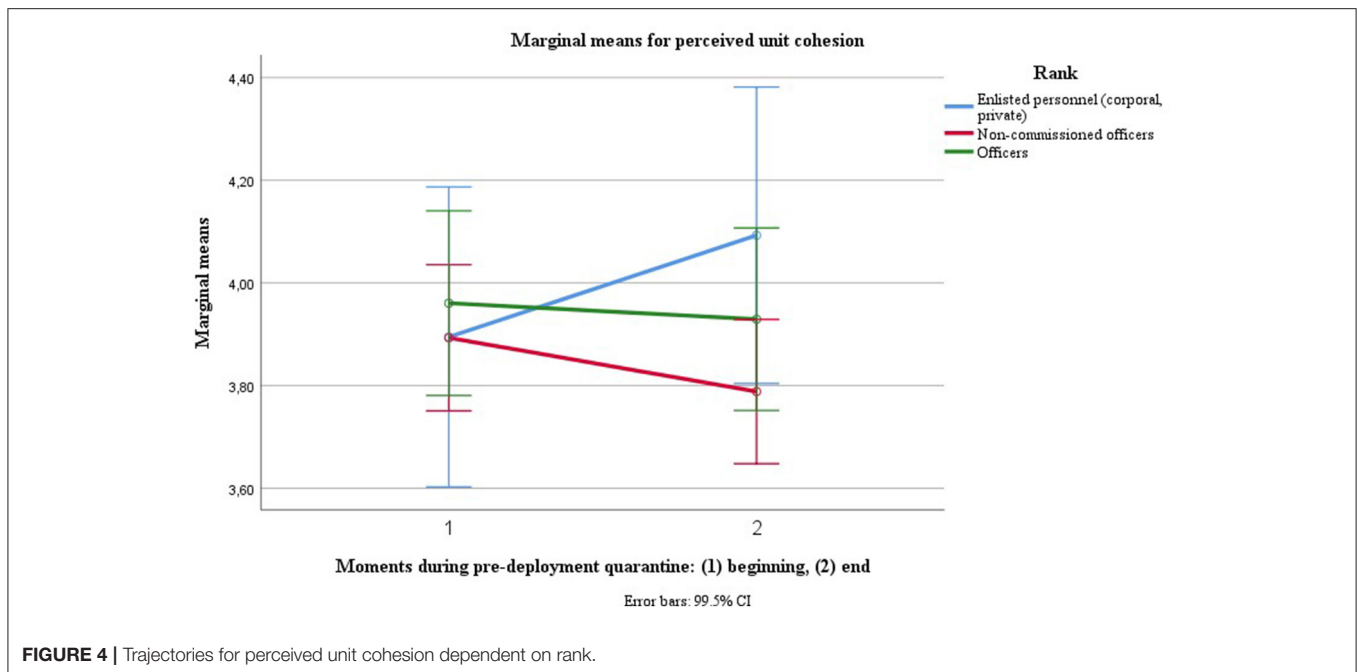


FIGURE 3 | Trajectories for perceived social support depending on age.

sociodemographic variables and 10 respective psychosocial variables. The nine sociodemographic predictors were age, gender, family status, number of children, single caretaker, children in pandemic-specific emergency care, accumulated days on deployment, and accumulated days quarantined when entering the pre-deployment quarantine. The identical 10

psychosocial predictors included health promoting leadership, feeling well-informed about Covid, perceived risk of a Covid infection, clarity of the quarantine protocol, perceived benefit/effectiveness of the quarantine, social norms supporting the quarantine, fulfilled need for bonding/intimacy, boredom, and financial disadvantage due to the quarantine. When



predicting mental health perceived social support and perceived unit cohesion were added to the predictors.

Potential collinearity due to intercorrelations between the predictors (see **Supplementary Material**) were addressed by carrying out stepwise regression analysis. The mean of all psychosocial variables was based on z-standardized items. When assumptions were violated, including the normal distribution of the residuals or outliers in casewise diagnostics ($> SD = 3$), the robustness of the model was tested by bootstrapping, when entering the predictors identified in stepwise regression analysis. Tables with correlations between sociodemographic variables, quarantine-related predictors and dependent variables can be found are documented in the **Supplementary Material** as well as potential changes in quarantine adherence and its predictors over the months.

Mental Health During the Course of Quarantine

Mental Health at the Beginning of Quarantine. A significant regression equation was found predicting mental health at the beginning of the quarantine, respective symptom severity (Mini_SCL) [$F_{(4,526)} = 25.50, p < 0.001$], with family status, fulfilled need for bonding/intimacy, unit cohesion and perceived social support explaining 15% of the variance ($R = 0.40, R^2 = 0.16$, corrected $R^2 = 0.15$, LL CI_{94%} = 0.11, LL CI_{94%} = 0.21, $\omega^2 = 0.16$), with fulfilled need for bonding/intimacy [$\Delta R^2 = 0.09, F_{(1,529)} = 49.97, p < 0.001$, LL CI_{99%} = 0.04, LL CI_{99%} = 0.15, $\omega^2 = 0.08$] explaining most of the variance.

Testing the robustness of the model by bootstrapping, the predictors identified “family status, unit cohesion, perceived social support, and fulfilled need for bonding/intimacy” were entered in regression analysis. The results of stepwise regression were supported by using bootstrapping in regression analysis [$F_{(4,564)} = 26.074, p < 0.001, R^2 = 0.16$, corrected $R^2 = 0.15$, LL

CI_{94%} = 0.10, UL CI_{94%} = 0.20, $\omega^2 = 0.15$], again with fulfilled need for bonding/intimacy [$\Delta R^2 = 0.08, F_{(1,567)} = 45.71, p < 0.001$, LL CI_{99%} = 0.10, UL CI_{99%} = 0.20, $\omega^2 = 0.07$] being the strongest predictor (see **Table 1**).

Predicting Mental Health at the End of Quarantine. A significant regression equation was found predicting mental health at the end of the quarantine, respective symptom severity (Mini_SCL) [$F_{(5,525)} = 17.42, p < 0.001$] by predictors assessed at the beginning of quarantine. The predictors explain 14% of the variance ($R = 0.40, R^2 = 0.16$, corrected $R^2 = 0.14$, LL CI_{94%} = 0.09, UL CI_{94%} = 0.19, $\omega^2 = 0.14$): age, accumulated days of quarantine before pre-deployment quarantine, fulfilled need for bonding/intimacy, perceived social support and boredom. Fulfilled need for bonding/intimacy [$\Delta R^2 = 0.05, F_{(1,529)} = 28.84, p < 0.001$, LL CI_{99%} = 0.01, UL CI_{99%} = 0.11, $\omega^2 = 0.15$] and perceived social support [$\Delta R^2 = 0.04, F_{(1,528)} = 24.27, p < 0.001$, LL CI_{99%} = 0.01, UL CI_{99%} = 0.10, $\omega^2 = 0.04$] were the strongest predictors. Testing the robustness of the model by bootstrapping, the predictors identified in exploratory stepwise regression analysis were entered in regression analysis. The results of stepwise regression were supported by using bootstrapping in regression analysis [$F_{(5,542)} = 17.98, p < 0.001, R = 0.38, R^2 = 0.14$, corrected $R^2 = 0.13$, LL CI_{94%} = 0.09, UL CI_{94%} = 0.19, $\omega^2 = 0.13$], with perceived social support [$\Delta R^2 = 0.05, F_{(1,544)} = 26.30, p < 0.001$, LL CI_{99%} = 0.01, UL CI_{99%} = 0.10, $\omega^2 = 0.04$] and fulfilled need for bonding/intimacy [$\Delta R^2 = 0.05, F_{(1,543)} = 29.95, p < 0.001$, LL CI_{99%} = 0.01, UL CI_{99%} = 0.11, $\omega^2 = 0.05$] being the strongest predictors (see **Table 2**).

Explaining Mental Health at the End of Quarantine. A significant regression equation was found predicting mental health at the end of the quarantine, respective symptom severity (Mini_SCL) [$F_{(7,523)} = 20.72, p < 0.001$] by predictors assessed at

TABLE 1 | Explaining mental health at the beginning of pre-deployment quarantine.

		B	SE	Beta	T	p	LL CI_{95.5%}	UL CI_{95.5%}	r (zero order)
1	(Constant)	0.014	0.024		0.594	0.553	−0.034	0.063	
	zt1_Need for bonding	−0.245	0.036	−0.273	−6.761	0.000	−0.318	−0.172	−0.273
2	(Constant)	0.014	0.024		0.603	0.547	−0.033	0.062	
	zt1_Need for bonding	−0.224	0.036	−0.250	−6.284	0.000	−0.296	−0.153	−0.273
	zt1_Unit cohesion	−0.159	0.031	−0.205	−5.165	0.000	−0.220	−0.097	−0.234
3	(Constant)	0.189	0.053		3.557	0.000	0.082	0.296	
	zt1_Need for bonding	−0.236	0.035	−0.263	−6.657	0.000	−0.307	−0.165	−0.273
	zt1_Unit cohesion	−0.170	0.031	−0.219	−5.553	0.000	−0.231	−0.108	−0.234
	Partnership	−0.218	0.060	−0.145	−3.664	0.000	−0.338	−0.099	−0.094
4	(Constant)	0.164	0.053		3.090	0.002	0.057	0.271	
	zt1_Need for bonding	−0.245	0.035	−0.273	−6.957	0.000	−0.315	−0.174	−0.273
	zt1_Unit cohesion	−0.140	0.031	−0.182	−4.488	0.000	−0.203	−0.078	−0.234
	Partnership	−0.187	0.060	−0.124	−3.140	0.002	−0.307	−0.067	−0.094
	zt1_Social support	−0.177	0.049	−0.145	−3.592	0.000	−0.276	−0.078	−0.189

Linear model of predictors with 95.5% bias corrected and accelerated confidence intervals (BCa CI). CI and standard errors (SE) based on 2,000 bootstrap samples. $R^2 = 0.08$ for Step 1, $\Delta R^2 = 0.04$ for Step 2, $\Delta R^2 = 0.02$ for Step 3, $\Delta R^2 = 0.02$ for Step 4, ($ps < 0.001$).

TABLE 2 | Predicting mental health at the end of quarantine.

		B	SE	Beta	T	p	LL CI_{95.5%}	UL CI_{95.5%}	r (zero order)
1	(Constant)	−0.044	0.029		−1.498	0.135	−0.103	0.015	
	Quarantining days before pre-deployment quarantine	0.005	0.001	0.137	3.221	0.001	0.002	0.008	0.137
2	(Constant)	0.271	0.111		2.436	0.015	0.047	0.494	
	Quarantining days before pre-deployment quarantine	0.005	0.001	0.140	3.318	0.001	0.002	0.008	0.137
	Age	−0.009	0.003	−0.124	−2.935	0.003	−0.015	−0.003	−0.120
3	(Constant)	0.221	0.109		2.023	0.044	0.001	0.440	
	Quarantining days before pre-deployment quarantine	0.005	0.001	0.131	3.173	0.002	0.002	0.007	0.137
	Age	−0.007	0.003	−0.103	−2.487	0.013	−0.013	−0.001	−0.120
	zt1_need for bonding	−0.195	0.038	−0.212	−5.128	0.000	−0.271	−0.118	−0.227
4	(Constant)	0.287	0.107		2.678	0.008	0.072	0.502	
	Quarantining days before pre-deployment quarantine	0.005	0.001	0.134	3.346	0.001	0.002	0.007	0.137
	Age	−0.009	0.003	−0.129	−3.183	0.002	−0.015	−0.003	−0.120
	zt1_need for bonding	−0.203	0.037	−0.221	−5.475	0.000	−0.277	−0.128	−0.227
	zt1_social support	−0.276	0.050	−0.221	−5.473	0.000	−0.377	−0.175	−0.192
5	(Constant)	0.527	0.131		4.028	0.000	0.264	0.789	
	Quarantining days before pre-deployment quarantine	0.005	0.001	0.139	3.499	0.001	0.002	0.008	0.137
	Age	−0.009	0.003	−0.120	−2.977	0.003	−0.015	−0.003	−0.120
	zt1_need for bonding	−0.166	0.038	−0.182	−4.327	0.000	−0.244	−0.089	−0.227
	zt1_social support	−0.272	0.050	−0.218	−5.438	0.000	−0.373	−0.172	−0.192
	zt1_boredom	−0.079	0.025	−0.132	−3.144	0.002	−0.130	−0.029	−0.194

Linear model of predictors, with 95.5% BCa CI. CI and SE based on 2,000 bootstrap samples. $R^2 = 0.02$ for Step 1, $\Delta R^2 = 0.02$ for Step 2, $\Delta R^2 = 0.05$ for Step 3, $\Delta R^2 = 0.05$ for Step 4, $R^2 = 0.02$ for Step 5, ($ps < 0.001$).

the end of quarantine. The predictors explain 20% of the variance ($R = 0.46$, $R^2 = 0.21$, corrected $R^2 = 0.20$, LL CI_{94%} = 0.15, UL CI_{94%} = 0.26, $\omega^2 = 0.21$): accumulated days of quarantine

before pre-deployment quarantine, age, clear communication of the quarantine protocol, perceived social support, fulfilled need for bonding/intimacy and perceived stigma, with clear

TABLE 3 | Explaining mental health at the end of quarantine.

		B	SE	Beta	T	p	LL CI_{95.5%}	UL CI_{95.5%}	r (zero order)
1	(Constant)	−0.044	0.029		−1.495	0.135	−0.103	0.015	
	Quarantining days before pre-deployment quarantine	0.005	0.001	0.137	3.215	0.001	0.002	0.008	0.137
2	(Constant)	0.271	0.111		2.431	0.015	0.047	0.495	
	Quarantining days before pre-deployment quarantine	0.005	0.001	0.140	3.311	0.001	0.002	0.008	0.137
3	Age	−0.009	0.003	−0.124	−2.930	0.004	−0.015	−0.003	−0.120
	(Constant)	0.222	0.107		2.070	0.039	0.007	0.437	
	Quarantining days before pre-deployment quarantine	0.004	0.001	0.121	2.991	0.003	0.001	0.007	0.137
	Age	−0.007	0.003	−0.102	−2.514	0.012	−0.013	−0.001	−0.120
4	zt2_clear quarantine protocol	−0.277	0.040	−0.283	−6.975	0.000	−0.357	−0.197	−0.299
	(Constant)	0.253	0.104		2.420	0.016	0.043	0.463	
	Quarantining days before pre-deployment quarantine	0.004	0.001	0.106	2.671	0.008	0.001	0.006	0.137
	Age	−0.008	0.003	−0.112	−2.836	0.005	−0.014	−0.002	−0.120
	zt2_clear quarantine protocol	−0.252	0.039	−0.257	−6.444	0.000	−0.330	−0.173	−0.299
5	zt2_social support	−0.250	0.046	−0.217	−5.452	0.000	−0.342	−0.158	−0.253
	(Constant)	0.221	0.103		2.151	0.032	0.015	0.427	
	Quarantining days before pre-deployment quarantine	0.004	0.001	0.102	2.627	0.009	0.001	0.006	0.137
	Age	−0.007	0.003	−0.099	−2.552	0.011	−0.013	−0.002	−0.120
	zt2_clear quarantine protocol	−0.212	0.039	−0.217	−5.422	0.000	−0.290	−0.133	−0.299
6	zt2_social support	−0.254	0.045	−0.221	−5.669	0.000	−0.345	−0.164	−0.253
	zt2_Need for bonding	−0.175	0.036	−0.194	−4.906	0.000	−0.247	−0.103	−0.252
	(Constant)	0.247	0.102		2.423	0.016	0.042	0.451	
	Quarantining days before pre-deployment quarantine	0.003	0.001	0.093	2.424	0.016	0.001	0.006	0.137
	Age	−0.008	0.003	−0.108	−2.809	0.005	−0.013	−0.002	−0.120
	zt2_clear quarantine protocol	−0.178	0.040	−0.182	−4.454	0.000	−0.258	−0.098	−0.299
	zt2_social support	−0.225	0.045	−0.196	−4.972	0.000			
	zt2_need for bonding	−0.150	0.036	−0.166	−4.152	0.000			
	zt2_stigma	−0.122	0.036	−0.143	−3.422	0.001			

Linear model of predictors with 95.5% BCa CI. CI and SE based on 2,000 bootstrap samples. $R^2 = 0.02$ for Step 1, $\Delta R^2 = 0.02$ for Step 2, $\Delta R^2 = 0.08$ for Step 3, $\Delta R^2 = 0.05$ for Step 4, $\Delta R^2 = 0.04$ for Step 5, $\Delta R^2 = 0.02$ for Step 6, ($ps < 0.001$).

communication of the quarantine protocol [$\Delta R^2 = 0.08$, $F_{(1,527)} = 47.31$, $p < 0.001$, LL CI_{99%} = 0.03, UL CI_{99%} = 0.15, $\omega^2 = 0.08$] being the strongest predictor.

Testing the robustness of the model by bootstrapping, the predictors identified in exploratory stepwise regression analysis were entered in regression analysis. The results of stepwise regression were supported by using bootstrapping in regression analysis [$F_{(6,539)} = 24.26$, $p < 0.001$, $R = 0.46$, $R^2 = 0.21$, corrected $R^2 = 0.20$, LL CI_{94%} = 0.15, UL CI_{94%} = 0.26, $\omega^2 = 0.20$], with clear communication of the quarantine protocol [$\Delta R^2 = 0.08$, $F_{(1,542)} = 48.66$, $p < 0.001$, LL CI_{99%} = 0.03, UL CI_{99%} = 0.15, $\omega^2 = 0.08$] and perceived social support being the strongest predictors [$\Delta R^2 = 0.05$, $F_{(1,541)} = 29.72$, $p < 0.001$, LL CI_{99%} = 0.01, UL CI_{99%} = 0.11, $\omega^2 = 0.05$] (see Table 3).

Adherence During the Course of Quarantine

Quarantine Adherence at the Beginning of Quarantine. A significant regression equation was found predicting quarantine at the beginning of the quarantine [$F_{(5,525)} = 89.87$, $p < 0.001$]. The variables social norms, perceived benefit/effectiveness of pre-deployment quarantine, boredom, perceived risk of infection with SARS-CoV2 and clear communication of the quarantine protocol explain 46% of the variance ($R = 0.68$, $R^2 = 0.46$, corrected $R^2 = 0.46$, LL CI_{94%} = 0.40, UL CI_{94%} = 0.51, $\omega^2 = 0.46$), with social norms being the strongest predictor [$\Delta R^2 = 0.37$, $F_{(1,529)} = 303.56$, $p < 0.001$, LL CI_{94%} = 0.28, UL CI_{94%} = 0.44, $\omega^2 = 0.36$].

Testing the robustness of the model by bootstrapping, all the predictors identified in stepwise regression analysis were entered in regression analysis using bootstrapping. The results of stepwise

TABLE 4 | Explaining quarantine adherence at the beginning of quarantine.

		B	SE	Beta	T	p	LL CI _{95.5%}	UL CI _{95.5%}	r (zero order)
1	(Constant)	0.004	0.021		0.164	0.870	-0.039	0.046	
	zt1_social norms	0.561	0.031	0.604	18.275	0.000	0.499	0.623	0.604
2	(Constant)	0.003	0.021		0.151	0.880	-0.039	0.045	
	zt1_Social norms	0.455	0.035	0.490	13.163	0.000	0.386	0.525	0.604
	zt1_Benefit/effectiveness	0.187	0.031	0.224	6.013	0.000	0.124	0.249	0.473
3	(Constant)	-0.370	0.073		-5.055	0.000	-0.517	-0.223	
	zt1_social norms	0.409	0.035	0.441	11.721	0.000	0.339	0.479	0.604
	zt1_Benefit/effectiveness	0.174	0.030	0.209	5.729	0.000	0.113	0.236	0.473
	zt1_boredom	0.112	0.021	0.176	5.305	0.000	0.069	0.154	0.367
4	(Constant)	-0.360	0.072		-4.978	0.000	-0.505	-0.214	
	zt1_QuSocNorm	0.402	0.034	0.433	11.664	0.000	0.333	0.471	0.604
	zt1_Benefit_QuEffective	0.143	0.031	0.172	4.641	0.000	0.081	0.206	0.473
	zt1_Boredom	0.108	0.021	0.171	5.222	0.000	0.067	0.150	0.367
	zt1_Perceived risk Covid	0.126	0.030	0.137	4.210	0.000	0.066	0.187	0.299
5	(Constant)	-0.338	0.072		-4.730	0.000	-0.482	-0.195	
	zt1_QuSocNorm	0.364	0.035	0.392	10.297	0.000	0.293	0.435	0.604
	zt1_Benefit_QuEffective	0.132	0.031	0.159	4.322	0.000	0.071	0.194	0.473
	zt1_Boredom	0.102	0.021	0.161	4.961	0.000	0.061	0.143	0.367
	zt1_Perceived risk Covid	0.130	0.030	0.142	4.399	0.000	0.071	0.190	0.299
	zt1_ClearCommunication quarantine protocol	0.145	0.037	0.132	3.974	0.000	0.072	0.219	0.364

Linear model of predictors with 95.5% BCa CI. CI and SE based on 2,000 bootstrap samples. $R^2 = 0.37$ for Step 1, $\Delta R^2 = 0.04$ for Step 2, $\Delta R^2 = 0.03$ for Step 3, $\Delta R^2 = 0.02$ for Step 4, $\Delta R^2 = 0.02$ for Step 5, ($ps < 0.001$).

regression were supported by using bootstrapping in regression analysis [$F_{(5,578)} = 98.95$, $p < 0.001$, $R = 0.68$, $R^2 = 0.46$, corrected $R^2 = 0.46$, LL CI_{94%} = 0.40, UL CI_{94%} = 0.50, $\omega^2 = 0.46$], again with social norms being the strongest predictor [$\Delta R^2 = 0.37$, $F_{(1,582)} = 333.97$, $p < 0.001$, LL CI_{94%} = 0.28, UL CI_{94%} = 0.43, $\omega^2 = 0.36$] (see **Table 4**).

Predicting Adherence at the End of Quarantine. A significant regression equation was found predicting quarantine adherence at the end of quarantine [$F_{(5,525)} = 98.50$, $p < 0.001$] by the sociodemographic variable age, and by the psychosocial predictors assessed at the beginning of quarantine, social norms, boredom, clear communication of the quarantine protocol and perceived benefit/effectiveness of the quarantine. These variables explained 48% of the variance ($R = 0.70$, $R^2 = 0.48$, corrected $R^2 = 0.48$, LL CI_{94%} = 0.42, UL CI_{94%} = 0.53, $\omega^2 = 0.48$), with social norms being the strongest predictor [$\Delta R^2 = 0.35$ change in $F_{(1,528)} = 298.21$, $p < 0.001$, LL CI_{99%} = 0.28, UL CI_{99%} = 0.43, $\omega^2 = 0.36$].

Testing the robustness of the model by bootstrapping, the predictors identified were entered into regression analysis. The results were supported when applying bootstrapping in regression analysis [$F_{(5,578)} = 108.43$, $p < 0.001$], explaining 48% of the variance in quarantine adherence at the end of quarantine ($R = 0.70$, $R^2 = 0.48$, corrected $R^2 = 0.48$, LL CI_{94%} = 0.43, UL CI_{94%} = 0.53, $\omega^2 = 0.48$), with social norms remaining the strongest predictor [$\Delta R^2 = 0.35$, $F_{(1,581)} = 328.15$,

$p < 0.001$, LL CI_{99%} = 0.28, UL CI_{99%} = 0.43, $\omega^2 = 0.36$; see **Table 5**].

Explaining Adherence at the End of Quarantine. When entering sociodemographic and psychosocial variable in two steps in stepwise regression, a significant regression equation was found predicting quarantine adherence at the end of quarantine [$F_{(7,455)} = 82.266$, $p < 0.001$] by the sociodemographic variable age [$R = 0.14$, $R^2 = 0.02$, corrected $R^2 = 0.02$, change in $F_{(1,529)} = 10.63$, $p = 0.001$, LL CI_{99%} = 0.0, UL CI_{99%} = 0.06, $\omega^2 = 0.02$], and by the psychosocial predictors social norms, boredom, perceived benefit/effectiveness of the quarantine and clear communication of the quarantine protocol. These variables explained 57% of the variance ($R = 0.76$, $R^2 = 0.58$, corrected $R^2 = 0.57$, LL CI_{94%} = 0.50, UL CI_{94%} = 0.60, $\omega^2 = 0.55$), with social norms being the strongest predictor [$\Delta R^2 = 0.45$, change in $F_{(4,459)} = 334.66$, $p < 0.001$, LL CI_{94%} = 0.36, UL CI_{94%} = 0.50, $\omega^2 = 0.43$].

When sociodemographic and psychosocial variables are entered in one step, the significant regression predicting adherence at the end of quarantine is also predicted by predictors social norms, boredom, perceived benefit/effectiveness of the quarantine, and clear communication of the quarantine protocol [$F_{(5,525)} = 145.38$, $p < 0.001$, $R = 0.76$, $R^2 = 0.58$, corrected $R^2 = 0.58$, LL CI_{99%} = 0.53, UL CI_{99%} = 0.62, $\omega^2 = 0.58$]. Instead of “age,” “perceived risk of infection” is added to the regression model [$\Delta R^2 = 0.01$, change in $F_{(1,579)} = 8.85$, $p = 0.003$, LL CI_{99%} = 0.00, UL CI_{99%} = 0.05, $\omega^2 = 0.01$] suggesting that age is a proxy

TABLE 5 | Predicting quarantine adherence at the end of quarantine.

		B	SE	Beta	T	p	LL CI_{95.5%}	UL CI_{95.5%}	r (zero order)
1	(Constant)	−0.394	0.119		−3.319	0.001	−0.632	−0.156	
	Age	0.011	0.003	0.140	3.419	0.001	0.005	0.018	0.140
2	(Constant)	−0.342	0.095		−3.600	0.000	−0.533	−0.151	
	Age	0.010	0.003	0.122	3.727	0.000	0.004	0.015	0.140
	zt1_Social norms	0.578	0.032	0.595	18.115	0.000	0.514	0.642	0.599
3	(Constant)	−0.925	0.110		−8.423	0.000	−1.145	−0.704	
	Age	0.008	0.002	0.097	3.139	0.002	0.003	0.013	0.140
	zt1_Social norms	0.486	0.032	0.500	15.377	0.000	0.422	0.549	0.599
	zt1_Boredom	0.196	0.022	0.296	9.060	0.000	0.152	0.239	0.467
4	(Constant)	−0.909	0.108		−8.422	0.000	−1.126	−0.692	
	Age	0.008	0.002	0.101	3.340	0.001	0.003	0.013	0.140
	zt1_Social norms	0.433	0.033	0.446	13.136	0.000	0.367	0.500	0.599
	zt1_Boredom	0.187	0.021	0.283	8.785	0.000	0.144	0.230	0.467
	zt1_clear quarantine protocol	0.176	0.038	0.153	4.665	0.000	0.100	0.251	0.376
5	(Constant)	−0.879	0.107		−8.218	0.000	−1.094	−0.664	
	Age	0.008	0.002	0.097	3.229	0.001	0.003	0.013	0.140
	zt1_Social norms	0.374	0.036	0.385	10.367	0.000	0.302	0.447	0.599
	zt1_Boredom	0.182	0.021	0.275	8.618	0.000	0.140	0.224	0.467
	zt1_clear quarantine protocol	0.164	0.037	0.142	4.376	0.000	0.088	0.239	0.376
	zt1_Effectiveness of quarantine	0.116	0.030	0.133	3.807	0.000	0.055	0.177	0.434

Linear model of predictors with 95.5% BCa CI. CI and SE based on 2,000 bootstrap samples. $R^2 = 0.02$ for Step 1, $\Delta R^2 = 0.35$ for Step 2, $\Delta R^2 = 0.08$ for Step 3, $\Delta R^2 = 0.02$ for Step 4, $\Delta R^2 = 0.01$ for Step 5, ($ps < 0.001$).

variable for “perceived risk of infection.” Social norms remains the strongest predictor in the equation [$\Delta R^2 = 0.43$, change in $F_{(1,529)} = 406.27$, $p = 0.000$, LL CI_{99%} = 0.36, UL CI_{99%} = 0.50, $\omega^2 = 0.43$].

Testing the robustness of the model by bootstrapping, the predictors identified were entered in regression analysis. The results were supported by using bootstrapping in regression analysis, [$F_{(5,579)} = 151.24$, $p < 0.001$], explaining 56% of the variance ($R = 0.75$, $R^2 = 0.57$, corrected $R^2 = 0.56$, LL CI_{94%} = 0.52, UL CI_{94%} = 0.60, $\omega^2 = 0.56$), again with social norms remaining the strongest predictor [$\Delta R^2 = 0.43$, change in $F_{(1,583)} = 447.73$, $p < 0.001$, LL CI_{99%} = 0.36, UL CI_{99%} = 0.50, $\omega^2 = 0.43$; see **Table 6**].

Due to stepwise regression the interrelated predictors were either omitted from the regression model or were left to explain a small proportion of the variance. However, relationships of social norms supporting quarantine adherence are associated with quarantine adherence and with the other quarantine-related factors with correlations varying between $r = 0.33$ and $r = 0.57$ ($p < 0.001$, $n = 566$). While the correlations are covered in the **Supplementary Material**, the most outstanding correlations with social norms supporting quarantine adherence should be cited here: perceived benefit/effectiveness of pre-deployment quarantine ($r = 0.57$), fulfilling the need for bonding/intimacy ($r = 0.35$, $p < 0.001$), clear communication of the quarantine protocol ($r = 0.45$, $p < 0.001$), practicality of the quarantine ($r = 0.40$), no financial disadvantage ($r = 0.34$), boredom ($r = 0.36$) health promoting leadership ($r = 0.33$).

As to changes of quarantine adherence over the period of assessment, February–July 2021, no association was found for quarantine adherence ($r = -0.03$, $p = 0.213$, $n = 579$), but for social norms supporting pre-deployment quarantine ($r = -0.12$, $p = 0.003$, $n = 579$) and for perceived risk of infection ($r = -0.104$, $p = 0.006$, $n = 579$).

DISCUSSION

This study analyzed (a) if pre-deployment individual quarantine might affect mental health, perceived social support, perceived unit cohesion, (b) if adherence with the quarantine protocol might change during quarantine, and (c) which factors impact on mental health and adherence with the quarantine protocol.

Mental Health

Mental health at the end of quarantine could only be explained by a percentage up to 20% with the most influential predictor being perceived social support. Mental health at the beginning and at the end of quarantine were explained by general perceived social support and by the fulfilled need for bonding and intimacy during quarantine. Only mental health at the beginning of quarantine was associated with being in a partnership and perceived unit cohesion; while only mental health at the end of quarantine could be partially predicted by age and accumulated days of quarantine and the quarantine-related factors of “clear communication of the quarantine protocol” and “perceived stigma.” Lower perceived resilience in dealing with pandemic-related behavioral

TABLE 6 | Explaining quarantine adherence at the end of quarantine.

		B	SE	Beta	T	p	LL CI_{95.5%}	UL CI_{95.5%}	r (zero order)
1	(Constant)	0.000	0.022		−0.020	0.984	−0.045	0.044	
	zt2_social norms	0.621	0.031	0.659	20.156	0.000	0.559	0.683	0.659
2	(Constant)	−0.001	0.021		−0.031	0.975	−0.043	0.041	
	zt2_social norms	0.532	0.031	0.564	17.063	0.000	0.469	0.594	0.659
	zt2_boredom	0.219	0.027	0.266	8.036	0.000	0.164	0.273	0.467
3	(Constant)	−0.001	0.020		−0.025	0.980	−0.040	0.039	
	zt2_social norms	0.436	0.032	0.463	13.551	0.000	0.372	0.501	0.659
	zt2_boredom	0.200	0.026	0.244	7.718	0.000	0.148	0.253	0.467
	zt2_clear quarantine protocol	0.267	0.035	0.248	7.544	0.000	0.196	0.338	0.509
4	(Constant)	0.000	0.019		−0.012	0.990	−0.039	0.038	
	zt2_social norms	0.349	0.034	0.371	10.129	0.000	0.280	0.419	0.659
	zt2_boredom	0.188	0.025	0.229	7.445	0.000	0.137	0.239	0.467
	zt2_clear quarantine protocol	0.243	0.035	0.226	7.044	0.000	0.174	0.312	0.509
	zt2_effectiveness quarantine	0.171	0.029	0.201	5.921	0.000	0.113	0.229	0.534
5	(Constant)	0.000	0.019		−0.012	0.990	−0.039	0.038	
	zt2_social norms	0.346	0.034	0.367	10.086	0.000	0.277	0.414	0.659
	zt2_boredom	0.186	0.025	0.226	7.426	0.000	0.136	0.237	0.467
	zt2_clear quarantine protocol	0.248	0.034	0.231	7.245	0.000	0.180	0.317	0.509
	zt2_effectiveness quarantine	0.148	0.030	0.174	4.970	0.000	0.088	0.208	0.534
	zt2_risk Covid	0.084	0.028	0.089	2.975	0.003	0.027	0.140	0.257

Linear model of predictors with 95.5% BCa CI. CI and SE based on 2,000 bootstrap samples. $R^2 = 0.43$ for Step 1, $\Delta R^2 = 0.06$ for Step 2, $\Delta R^2 = 0.05$ for Step 3, $\Delta R^2 = 0.03$ for Step 4, $\Delta R^2 = 0.01$ for Step 5, ($ps < 0.001$).

restrictions for young adults is in line with large representative analyses by the Covid Snapshot Monitoring (COSMO) (71) and previous reviews (15, 33). The general strong health protective function of perceived social support is in line with several meta-analyses (57, 72) and the only study on military quarantine, post-deployment collective quarantine (12).

In contrast to previous research for civilian quarantining or isolation following a suspected or confirmed infection, we did not find a significant overall deterioration of mental health during pre-deployment quarantine. We also did not find an overall decrease in perceived social support or perceived unit cohesion. However, for two subgroups we found differing trajectories in respect to mental health and the health protective factors of perceived social support and perceived unit cohesion: Mental health slightly deteriorated over the course of pre-deployment quarantine with increasing accumulated days of isolation. Perceived unit cohesion slightly decreased over the course of pre-deployment for middle rank soldiers, while it increased for lower rank soldiers and remained unaffected for higher ranks. Differing from international research highlighting female gender as a risk factor for adverse mental health impacts by the pandemic in general, potentially facilitating cardiovascular diseases (73, 74), and isolation/quarantine in particular (15, 33), we did not find such effects. One potential explanation is that

the protective factors of perceived unit cohesion and perceived social support do not differ between the male and female soldiers and that many of the pandemic- and quarantine-related stress factors have been addressed before pre-deployment quarantine or by quarantine management itself.

Previous rapid and systematic reviews (15, 33) found that length of quarantine and isolation itself is associated with mental health. In our study, we did not look at the impact of one single quarantine, as we expected the length of pre-deployment quarantine not to vary extensively and the pandemic had been going on for a year when the data collection started. We analyzed if the accumulated days of quarantine during the pandemic impacted on mental health over the course of pre-deployment quarantine. To our knowledge, this is the first empirical evidence how previous quarantining or isolation experience is influencing the trajectory of mental health and perceived social support over the course of a new quarantine at the same time controlling for the factor of infection-related traumatic experience. As the occasion for pre-deployment quarantining is neither a confirmed infection with Covid nor a contact with an infected person, infection-associated traumatic experience can be excluded as an influencing factor in this case.

Further explanations for the mental health of soldiers overall is not affected by pre-deployment quarantine are (1) that this is a

very healthy sample as they are screened for medical fitness pre-deployment, (2) the protective factor of perceived unit cohesion in spite of being individually isolated, and (3) that many of the quarantine-associated conditions associated with mental health effects and quarantine adherence were addressed during pre-deployment quarantine.

The slight deterioration in mental health associated with accumulated days in quarantine are not considered to be alarming at this point. However, this conclusion does not exclude that the mental health of a number of soldiers is seriously affected by pre-deployment quarantine respective an accumulation of stress factors. The longer-term impact on mental health should be followed up in research. Concerning practical implications, preventive measures are recommended including (a) screening for accumulated days of quarantining prior to pre-deployment quarantining and (b) designing compensatory measures facilitating perceived social support for soldiers with previous quarantining experience and facilitating perceived unit cohesion for soldiers with middle ranks. In addition, an observation of longer term-effects on mental health is recommended. While the need for bonding and intimacy can just be partially influenced during individual isolation conditions by providing good coverage for mobile phone connections and long-term holiday planning, the quarantine-related factors boredom and perceived stigma by fellow soldiers could be addressed by health promoting leadership. Though health promoting leadership did not additionally contribute to predicting mental health, it was found to be associated with mental health and positive social norms toward the pre-deployment quarantine and in particular strongly associated with unit cohesion (see **Supplementary Materials**).

Quarantine Adherence

Quarantine adherence could be explained up to 58% by positive social norms toward the quarantine, perceived benefit/effectiveness of quarantine, boredom, perceived risk of infection and clear communication on the quarantine protocol. This result is in line with previous international research (16). COSMO kindly supported us with additional calculations with the purpose of contextualizing of our results for the specific military subgroup with the German population for different assessment waves throughout the pandemic (COSMO, University Erfurt on August 17, 2021). The result of age being a proxy for perceived risk of infection with Covid and perceived resilience to quarantining also conforms with results reported by the Covid Snapshot Monitoring (COSMO) in Germany (71), with young adults between 18 and 29 years considering the risk of being severely infected with the Covid-19 virus as substantially lower as well as their own (psychological) resilience (assessment waves 7 through to wave 13, 14/04–27/06/20 based on calculations provided by Universität Erfurt, COSMO, on August 17, 2021).

For the German civilian population, the knowledge that quarantining is an official directive had the strongest relationship with quarantine adherence, being followed by having been infected with Covid-19. The two most prominent predictors of adherence with the quarantine or isolation protocol for the

German civilian population do not show variability with military quarantinees, as there is no way to ignore for the military quarantinees that pre-deployment quarantine has been ordered as quarantinees are neither ordered to quarantine because of an infection or having been in close contact with an infected person. Additional manipulation checks do not show any significant correlations between quarantine adherence and having been infected ($r = -0.048$, $p = 0.077$, $n = 588$) nor between perceived infection risk and having been infected ($r = -0.006$, $p = 0.432$, $n = 536$).

Quarantine adherence and predictors for quarantine adherence in Germany depend on the waves of data collection (calculations provided by COSMO, University Erfurt on August 17, 2021). Self-reported 100% self-isolation following symptoms varied between 57 and 32%. One hundred percent adherence with the quarantine regulations (when having had a confirmed contact with a person tested positive for SARS-COV-2) varied between 50 and 43% (data provided by COSMO on 17th August, 21). These changes seem to reflect perceived risk of infection, as adherence varies with incidence and hospitalization rates over the year. This suggests that quarantine adherence and the weight of its predictors also could change over the course of the pandemic for adherence with pre-deployment quarantine.

More surprising was the effect related to gender in light of previous research describing quarantine adherence as higher for female gender by international research (16–18) as well as by the regular Covid-19 Snapshot Monitoring for Germany (71). The initially indeed slightly higher quarantine adherence for female soldiers decreased over the course of quarantine, leveling in with quarantine adherence of male soldiers at the end of quarantine—in spite of female soldiers initially rating practicality and the benefit/effectiveness of pre-deployment quarantine higher than male soldiers. According to our *post-hoc* exploratory analysis, this gender effect most likely can be attributed to correlations with mental health, though no differences for mental health were found for gender.

The most striking result, from our point of view, was that the strongest predictor was “social norms of relevant others supporting pre-deployment quarantine” predicting more than 40% of quarantine adherence.

Based on these results, the following measures are suggested for facilitating quarantine adherence: Relevant partners and family should be involved in pre-deployment quarantine management. Successfully addressing quarantine-related beliefs and behaviors by military leaders is helped by them being perceived as caring for the well-being of their soldiers (health promoting leadership). Special attention should be paid to younger soldiers by military supervisor, older fellow soldiers and eventually military psychologists addressing perceived infection risk, benefit of the quarantine, perceived social support, and the social norms of fellow soldiers.

The questions remains as how to achieve the goal of relevant others supporting the pre-deployment quarantine (protocol). This is easier said than done. Here, the relationships between the predictors might shed some light, in particular the positive relationship of social norms supporting pre-deployment quarantine with (in descending order) perceived

benefit/effectiveness of pre-deployment quarantine and the quarantine protocol, bonding needs, clear communication of the quarantine protocol, practicality of the quarantine, no financial disadvantage, less boredom and health promoting leadership, with correlations varying between $r = 0.3$ and $r = 0.56$ ($p < 0.001$, $n = 566$). This suggests that a multifaceted approach addressing these factors, also by the help of health promoting leadership could promote supportive social norms and quarantine adherence. As suggested by health supporting leadership and the fulfillment of bonding need and social norms, this is not only a rational, but an emotional and social endeavor.

However, there might be a limit as to which support for pre-deployment quarantine can be facilitated: Though quarantine adherence did not decrease between February and July 2021 (see **Supplementary Material**), two of the relevant predictors did: social norms supporting the quarantine and perceived risk of infection. As to the most influential predictors of quarantine adherence, we cannot determine if decreasing perceived risk of infection and perceived positive social norms toward the quarantine over the course of the study period were due to the increasing immunization, decreasing incidence rates, habituation, complacency or a mix of these factors. While we cannot single out the one reason, this development suggests that quarantine adherence will decline in the mid- or longterm as well, in particular due to relevant others, including family/partner and fellow soldiers, becoming more critical toward pre-deployment quarantine. In this light of perceived decreasing support, it is recommended (a) to keep ordered quarantining commensurate. This development could be observed as mandatoriness and length of pre-deployment quarantine have been changed dependent on immunization status, country of deployment, and policies of international organizations (United Nations, NATO). At the same time, deploying soldiers still ordered to quarantine, their families/partners and fellow soldiers might need even clearer leadership communication as to why they have to quarantine and others have not to.

Limitations and Strengths

This prospective design included a large sample which was close to representative for the troops deploying between February and July 2021. To our knowledge, it is the first prospective study on the impact of quarantining. This particular kind of planned pre-deployment quarantine provided a rare opportunity to control a number of quarantine-related factors resulting in an almost quasi-experimental study: the absence of infection-related traumatic experience, the practicalities, including provision of daily needs and medical care, a 24/7-h hotline, financial disadvantage and compensation for the period of confinement.

Limitations of our study are that we did not ask about actual violations of the quarantine protocol, as receiving knowledge about such transgressions would have obliged us as researchers and military personnel to report breaching the confidentiality of the information and leading to investigations and disruptions of the deployment. The pandemic did not allow

for recruiting a control group of soldiers deploying without being quarantined. Missing information on sociodemographic variables partially resulted into excluding up to 130 cases from a sample of 600. Potentially biased results due to these exclusions cannot be fully ruled out. Results for small groups, including female gender and single caretakers have to be regarded with some caution, e.g., the non-significant relation for female soldiers with more adverse mental health than male soldiers at the end of quarantine ($r = 0.073$, $p = 0.041$, $n = 573$; see **Supplementary Material**), though these groups were not underrepresented when comparing with the percentage of these groups deploying.

During the recruitment period, the inoculation program started resulting in a growing number of partially and fully vaccinated soldiers reaching almost 100% of fully vaccinated deploying soldiers in July 2021. At the point of the study proposal, we expected the pre-deployment quarantine to be discontinued for vaccinated soldiers. Therefore, we did not include questions about vaccinations. Controlling for time of assessment could capture the effect of inoculation as well as a habituation effect in respect to perceived risk of infection or a realistic assessment of decreasing incidence rates with the summer approaching. The social norms toward the quarantine were perceived as less supportive over time; again this could be attributed to vaccinations as well as decreasing incidence rates. For the very slight tendency of quarantine adherence decreasing toward the summer, no significant effect was found.

Future Research

Summing up avenues for future research, we recommend to follow up on the long-term impact of pre-deployment quarantining on mental health and the protective factors of perceived social support and unit cohesion. The quality of research could be strengthened by including control groups though possibly not during the pandemic and by further validating the assessment instruments, in particular by assessing the associations between the adherence questionnaire with actual violations of the quarantine protocol. Further insights into factors shaping quarantine adherence could be won by comparing military and civilian quarantine.

AUTHOR'S NOTE

Military Hospital Berlin (for regular costs for conducting the study) Medical Academy of the German Armed Forces (Sanitätsakademie der Bundeswehr). Coping with risky deployment abroad requires mental and physical readiness. This study provides first insights into how military pre-deployment quarantine affects mental health and quarantine adherence and its mitigating factors. Studying soldiers' pre-deployment quarantine provides the unique opportunity of a quasi-experimental design. External factors identified to influence mental health and quarantine adherence are controlled for by the military setting, which provides the military quarantinees with regular briefings on Covid and the quarantine, necessary supplies, financial safety and compensation. Quarantine-protocol

violations are quite likely to be detected, investigated and to result in disciplinary measures. Foremost, in this quarantine setting, the potential traumatic factor of being infected with a health- or life-threatening disease is absent, thereby allowing to isolate the impact of the quarantine from the impact of the traumatic event. Studies on quarantining and isolation found adverse mental health effects for those in quarantine and isolation based on cross-sectional and retrospective longitudinal designs. To our knowledge, this is the first study with a prospective design analyzing mental health and quarantine adherence over the course of the quarantine, as well as changes in the protective factors perceived social support and its military-specific form, perceived unit cohesion.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because they form a part of an ongoing longitudinal study of which ownership belongs to the German Ministry of Defense. Requests to access the datasets should be directed to the authors, gerddieterwillmund@bundeswehr.org and antjeheikebuehler@bundeswehr.org.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Charité Ethics Committee, Ethics' Approval of registered research proposal EA1/388/20. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpubh.2021.802180/full#supplementary-material>

Overview of Supplementary Materials

1. Calculation of Required sample sizes (ad 2.4.1)

Correlations between

2. Sociodemographic factors (table 1)

Correlations between sociodemographic factors and

3. Quarantine adherence and mental health (table 2)
4. Perceived social support (table 3)
5. Perceived unit cohesion (table 4)
6. Health promoting leadership (table 5)
7. Quarantine-related psychosocial factors assessed at the beginning of pre-deployment quarantine (table 6)
8. Quarantine-related psychosocial factors assessed at the end of pre-deployment quarantine (table 7)

Correlations between

9. Quarantine adherence, mental health, perceived social support, perceived unit cohesion and health promoting leadership (table 8)
10. Quarantine-related psychosocial factors assessed at the beginning of quarantine (table 9)
11. Quarantine-related psychosocial factors assessed at the end of quarantine (table 10)
12. Quarantine-related psychosocial factors assessed at the beginning and at the end of quarantine (table 11)

Correlations between

13. Quarantine-related psychosocial factors assessed at the beginning of pre-deployment quarantine on the one hand and quarantine adherence and mental health assessed at the beginning and at the end of pre-deployment quarantine (table 12)
14. Quarantine-related psychosocial factors on the one hand and quarantine adherence and mental health assessed on the other hand, all assessed at the end of pre-deployment quarantine (table 13).

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Longitudinal Effects of Distress and Its Management During COVID-19 Lockdown in Spain

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Introduction: The COVID-19 pandemic that hit Spain during March 2020 forced the strict confinement of the population for 2 months. The objectives of this study were (a) to assess the magnitude and duration of the influence of confinement on people's Distress, (b) to study the temporal sequence of stress, and (c) to show how different day-to-day activities and personal variables influence perceived Distress levels.

Method: A daily registration was completed by 123 people, with ages ranging from 21 to 75 years old ($\bar{X} = 43$, $SD = 10$ years), of which there were 40 men (32%) and 83 females (68%). During 45 days of lockdown, from March 19th to May 3rd, participants were asked to respond to a socio-demographic survey and make daily records comprising the MASQ-D30 and some day-to-day behaviors. Pooled time series was applied to establish what effect time had on the dependent variable.

Results: Distress has a 14-day autoregressive function and gender, physical activity, sexual activity, listening to music, and teleworking also influence Distress. It has been hypothesized that the intercept presents variability at level 2 (individual), but it has not been significant. Interactions between Gender—Telecommuting, and Gender—Physical Activity were observed. Approximately 66% of the variance of Distress was explained ($R^2 = 0.663$).

Discussion: At the beginning of the lockdown, the average levels of Distress were well above the levels of the end ($z = 3.301$). The individuals in the sample have followed a very similar process in the development of Distress. During the lockdown, the “memory” of Distress was 2 weeks. Our results indicate that levels of Distress depend on activities during lockdown. Interactions exist between gender and some behavioral variables that barely influence Distress in men but decrease Distress in women. The importance of routine maintenance and gender differences must be considered to propose future interventions during confinement.

Keywords: longitudinal, distress, gender, lockdown, pooled time series, intensive methods

INTRODUCTION

The global pandemic situation due to SARS-CoV-2 (COVID-19) made several countries implement exceptional and severe measures to prevent the spread of the illness. The last two decades have seen a growing trend of different epidemic outbreaks that have taken place around the world, such as the polio epidemic in Uttar Pradesh (India), the SARS epidemic, the H₁N₁ flu pandemic threat, the Middle East respiratory syndrome coronavirus (MERS-CoV), and the Zika epidemic in Latin America. However, none of these sanitary alerts impacted at the level the COVID-19 has. Not since the 1918–1920 flu pandemic has there been a need to fight against such a high infection rate, and with so many psychological and physical health consequences. During the COVID-19 crisis, worldwide lockdown and quarantine measures were taken, and previous lockdown situations have taken place as happened in several areas of China (Guan et al., 2003) and Canada due to SARS (Hawryluck et al., 2004), and in other African countries during the Ebola virus epidemic in 2014 (Frieden et al., 2014). Hawryluck et al. (2004) report that post-traumatic stress disorder and depression were found in 30% of their studied sample, and that these diagnoses were related to the lockdown period.

In this regard, Brooks et al. (2020) have elaborated a systematic review about psychological impact in quarantine and lockdown, in order to explore the possible mental and psychological wellbeing effects that can be caused, and the factors that may prevent these effects. This revision points out stressors that can account during lockdown (such as duration, fear of infection, boredom, frustration, insufficient resources, and inadequate information), and after isolation due to lockdown (such as economic problems and social stigma). Regarding the effects during lockdown, it has been observed that physical activity seems to work as a protector factor in the prevention of depression, stress, and anxiety symptoms (Stanton et al., 2020). Reducing physical activity during lockdown had a negative impact on mood, as did the decrease in the sleep quality (Chouchou et al., 2020; Ingram et al., 2020). Although it is yet unclear if sleep impairment produces a negative mood or vice versa, several studies have been carried out in relation to it. Anyway, lockdown seems to have changed sleeping patterns (Gupta et al., 2020), following a general tendency of going to sleep and waking up later but perceiving a lower quality of sleep (Cellini et al., 2020).

It has been previously observed that quarantine can lead to emotional and psychological problems (Palinkas et al., 2004), and in order for lockdowns to be effective, not only people at risk should obey it, but also people who are used to having full rights and liberties. These exceptional lockdown situations have been studied in exceptional cases such as astronauts, scientific expeditions to Antarctica, or any other situation where people have been previously trained, generally focusing on the possible causes for tension and interpersonal conflict, or exposure to extreme conditions (Palinkas et al., 2000; Kanas et al., 2001; Rosnet et al., 2004; Steel, 2005; Sandal et al., 2006). No previous studies have investigated the psychological effects on an untrained population

in a natural space when going through long periods of quarantine, until now.

Distress has generally been defined or divided between acute or chronic stress. The first one is a quick reaction to a situation that could develop into positive or negative emotions, though stress is typically related to negative affect. Distress is an interesting variable to analyze and study in an exceptional situation such as compulsory and obligatory lockdown, due to the possible post-traumatic stress disorders that could be developed. A prolonged situation of Distress can have a negative impact on the motivation needed to do activities that will act as a protective factor in the prevention of developing mood disorders. For example, high levels of stress influence a person's life in many other aspects such as insomnia induced by high cortisol levels (Rodenbeck et al., 2002; Nandkar, 2020), furthermore it reduces the motivation to perform chores or responsibilities and includes other responses such as eating too much or not eating enough (Dua, 2019).

According to Watson (2000, p. 158) there exists a relation between stress or distress and feeling upset therefore, negative affect. But at the same time, people who tend to have negative emotions when experiencing high stress levels also tend to have negative emotions in low stress level situations. This could imply the importance of coping strategies when studying the duration or magnitude of stress. It is important to highlight that stress “*per se*” is not considered to be an emotion, but derives in negative or positive emotions; therefore, it is normally included within the negative affect dimension within mood, and its duration has been mainly studied in terms of hormones and neurotransmitters (Burke et al., 2005; Reeve, 2014, p. 75).

Stress has become the “disease” of the twenty-first century, according to the World Health Organization (Fink, 2016). It was initially a concept used to refer to neurobiological activations that take place with the presence of a stimulus that is considered harmful or dangerous (Smyth et al., 2013), and therefore “fight or flight” mechanisms begin due to the perception of a break up in the homeostasis of a person (Cannon, 1914). Nowadays, stress is not seen as “acute stress,” but rather seen as “chronic stress,” understood as feeling stress during a prolonged time frame (Senanayake and Arambepola, 2019). Traditionally, stress has been defined as the actions a person makes in order to react to a certain demand for change (Selye, 1965). Moreover, it is defined as a perceived feeling of too much demand (for example, work or chores) and not having enough resources to cope with the demands (Cherniss, 1980). It can also be defined as a threat being perceived by a person who feels incapable to cope with it (Biggs et al., 2017), based on Lazarus and Folkman's transactional theory of stress and coping. In many cases, the concept of stress has been divided into “good” and “bad” stress, identifying eustress as “good stress” and Distress as “bad stress,” according to Selye (1976). However, Bienertova-Vasku et al. (2020) suggest that stress and Distress can be used indistinctively. As with any other emotion or feeling, stress can have the power to spill over and affect other people around you in a negative way. The term “adult coregulation” would also appear here. This means the power of “influencing each other's moods and physiology” (p. 92) according to Saxbe and Repetti (2010).

One of the main obstacles or limitations in the papers and reviews consulted indicate that few studies follow subjects over time to observe the cyclical patterns of Distress, the study of its effect or forecasting the effect of distress, and how the different behaviors and activities that a person carries out influence Distress levels. In this sense, the studies found have generally focused on the population with mental health problems and some behaviors related to stress, such as tobacco consumption (Lawrence and Williams, 2016); subjects with medical problems, such as cancer survivors (Brinkman et al., 2013); or on specific situations of the subjects, such as marital disruption (Johnson and Wu, 2002); but not on general population cohorts, in a situation like the recently experienced lockdown, observing those daily life activities and behaviors that could be modulating experienced Distress.

The objective of applying pooled time series is to establish what effect Time has on the dependent variable (Distress) in different individuals. Pooled time series can detect the effect that the same variable has on itself through autoregressive models, where the independent variables (IVs) are past values of the same dependent variable (DV), and the different behaviors that people use to cope with Distress. In short, more quantitative studies are needed on the effect of a stressful phenomenon on the positive or negative mood of a person. In our case, we will study the Distress, as a variety of negative mood, produced by lockdown as a stressful event.

The use of autoregressive models is very useful since many physiological parameters and human behavior itself present cyclicity, regularity, and continuity. In addition, from a methodological perspective, cross-sectional models assume the serial independence of data, which does not occur in longitudinal studies since the longitudinal variable (DV) is correlated with past values of itself. Then, if longitudinal data were analyzed with cross-sectional models, Kmenta (1971, p. 283) demonstrated that the residuals will be autocorrelated, the parameters ($b_0, b_1, \dots$) are not biased, but the variances of the errors are underestimated. Therefore the variances and the standard errors of the parameters (that are in the denominator) also tend to be underestimated and, likewise, the values of the t , z , F , R^2 , and $b_0, b_1, \dots$ statistics are overestimated and not efficient, leading to type I errors (the assumption that a statistical effect exists, when in fact it does not) (Gujarati and Porter, 2013; Rosel et al., 2019). In addition, if we omit the values of the lagged variable, and this variable is part of the explanatory model of behavior, the coefficients obtained are biased and inconsistent, so the inferences drawn no longer have a substantive meaning (Gujarati and Porter, 2013; Draper and Smith, 2014).

This paper attempts to (a) assess the magnitude and duration of the influence of confinement on people's Distress; (b) study the temporal sequence of stress, checking in what way and for how long the stress of any given day influences the subsequent Distress of a person; and (c) show how different activities carried out during the day (such as telecommuting, physical activity at home/building, have sexual activity and listening to music) influence in perceived Distress levels, using a daily survey. As we are working with temporal data, autoregressive models are more suitable to analyze cyclicity depending on the different

daily activities that are carried out to face the lockdown. Our hypotheses have been established as follows:

- Distress will have increased in each individual since the start of confinement, but then its impact has decreased over time.
- Distress presents an autoregressive memory function, so that a high level of Distress during a given day will last for a period (up to 14 days).
- There will be a set of variables and behaviors that will modulate the perceived Distress levels during the period of confinement. We hypothesized that gender and age affect the perceived Distress levels. The behaviors that have been considered are telecommuting, physical activity, sexual activity, and listening to music.
- An interaction effect will be observed between gender (male/female) and Distress perceived "the day before" affecting men and women differently ($StD_{t-1} \cdot Gender$), as well as in variables and behaviors mentioned in "c."

The intercept has been left as a Level 2 random variable (per participant). These hypotheses will be formalized in the data analysis from a regression equation, where the DV will be the daily Distress and the IV's will be each of the variables indicated in the hypotheses in addition to the corresponding interactions of the variables, in order to verify its compliance or its empirical refutation, being the hypothetical equation:

$$\begin{aligned}
 StD_{tk} = & (b_0 + b_{0k}) + [b_1 \cdot StD_{t-1} + b_2 \cdot StD_{t-1} \cdot Gender] \\
 & + b_3 \cdot StD_{t-2} + b_4 \cdot StD_{t-3} + b_5 \cdot StD_{t-4} + b_6 \cdot StD_{t-5} \\
 & + b_7 \cdot StD_{t-6} + b_8 \cdot StD_{t-7} + b_9 \cdot StD_{t-8} + b_{10} \cdot StD_{t-9} \\
 & + b_{11} \cdot StD_{t-10} + b_{12} \cdot StD_{t-14} + [b_{13} \cdot Telecommuting \\
 & - b_{14} \cdot Telecommuting \cdot Gender] - b_{15} \cdot Sexual Activity \\
 & + [b_{16} \cdot Listen to music + b_{17} \cdot Listen to music \cdot Gender] \\
 & + [b_{18} \cdot Sport + b_{19} \cdot Sport \cdot Gender] + b_{20} \cdot Gender \\
 & - b_{21} \cdot Age + \varepsilon_{tk}
 \end{aligned} \quad (1)$$

In Equation 1 b_{0k} is the Level 2 intercept coefficient (participant), k refers to each individual in the sample; $b_0, b_1, \dots, b_j$ are the coefficients of each variable, respectively; StD is the Stabilized Distress variable; and the main variables with their corresponding interactions have been placed between square brackets. The subscript " $t-1$ " is the value of that same variable delayed 1 day, " $t-2$ " delayed 2 days, and so on up to " $t-14$ ".

MATERIALS AND METHODS

Participants

The initial sample consisted of 319 participants recruited voluntarily through social media (web forums, WhatsApp, Twitter, and Facebook). Finally, 123 participants were selected from the total, because participants with less than 25 observations or non-consecutive registries were excluded. Participants were asked to respond to a socio-demographic survey first, where

personal information and information about their physical activity and sleep quality pre-pandemic was requested. Several variables were collected in the sociodemographic questionnaire such as age, gender (male/female), education levels, marital status, number of people who were living with them during lockdown, and work status (essential/not essential) before the sanitary alert. From the fourth day after the start of the confinement in Spain (March 19th, 2020) until the de-escalation period (May 3rd, 2020), participants had to respond on the scales later described in the “Instruments and Variables” section. Due to the selection of participants carried out, **Table 1** shows characteristics and basic differences of the group “participants” and “excluded.”

The final sample of 123 participants’ mean age was 42.80 (between 21 and 75 years old), with a standard deviation of 10.35 years. The sample included 40 men (32.5% of the total sample) and 83 women (67.5% of the total sample). Approximately half of the sample ($n = 73$, 59.3%) lived with a partner, whilst 40.7% ($n = 50$) were divorced or single. Up to 70% had university or postgraduate education ($n = 95$, 77.3%), 21.1% ($n = 26$) had secondary education and only 2 people (1.6%) had primary/basic education. Regarding sleep characteristics and physical activity pre-lockdown, we found that up to 70% had Fairly Good or Very Good sleep quality ($n = 86$, 74.8%) previous to the confinement vs. 25.2% ($n = 29$) who had Fairly Bad or Very Bad sleep quality. Regarding Physical Activity, 78.8% ($n = 97$) of the sample achieved the WHO recommendations, with 83.7% ($n = 103$) of the subjects performing intense or moderate physical activity before confinement. Of the total sample, 22 subjects (17.9%) lived alone during lockdown; the rest of the sample lived with their couple, children, parents, or other relatives, and/or pets. In Spain, critical workers (those necessary for the maintenance of basic social functions, health, security, social and economic well-being of citizens, or the efficient functioning of state institutions and public administrations) were allowed to go out to do their jobs (32.5% of the sample, $n = 40$), while non-essentials had to perform strict confinement and/or telecommute (67.5%, $n = 83$). Only 2 people (1.62%) were diagnosed positive with COVID-19 previously to the lockdown.

The 123 participants filled out a total of 4,924 daily records. However, when we introduce autoregressive variables of the same dependent variable up to a delay of 14 days, which causes the first 14 temporal data of each subject to be lost, the number of useful records is 3,132. No missing data have been estimated, and we have used the procedure of deleting the entire data line when there was any missing data, using the “LISTWISE” procedure in SPSS.

Instruments and Variables

The main part of the daily record was comprised by the Adaptation of the Mood and Anxiety Symptom Questionnaire (MASQ-D30) Scale (Wardenaar et al., 2010) made by González and Ibáñez (2018) and also called MASQE-30, which comprises a total of 30 items designed to measure the three dimensions of the tripartite model of anxiety and depression: negative affect (NA), positive affect (PA), and somatic anxiety (SA) (Clark and Watson, 1991). According to Wardenaar et al. (2010) the three dimensions

TABLE 1 | Main descriptive statistics, including the contrast between excluded and selected subjects in the study.

		Excluded		Participants	
		N	%	N	%
Age [mean (SD)]		39 ^a	11	43 ^b	10
Gender	Woman	67 ^a	27.70%	83 ^a	34.30%
	Male	52 ^a	21.50%	40 ^a	16.50%
Studies	Primary/Basic	5 ^a	2.00%	2 ^a	0.80%
	Secondary (School/Vocational training)	36 ^a	14.80%	26 ^a	10.70%
	Higher (Advanced VT/University)	61 ^a	25.00%	66 ^a	27.00%
	Postgraduate (Master/PhD)	19 ^a	7.80%	29 ^a	11.90%
Marital status	Married/In union	59 ^a	24.70%	73 ^a	30.50%
	Separated/Divorced	10 ^a	4.20%	15 ^a	6.30%
	Single/Without a partner	47 ^a	19.70%	35 ^b	14.60%
COVID-19 diagnosed	Yes	2 ^a	0.80%	2 ^a	0.80%
	No	118 ^a	48.60%	121 ^a	49.80%
Shared dwelling	Living alone	11 ^a	4.60%	22 ^a	9.20%
	With one person	30 ^a	12.60%	40 ^a	16.70%
	With two persons	27 ^a	11.30%	26 ^a	10.90%
	With three or more	49 ^a	20.50%	34 ^b	14.20%
Physical health	Excellent	10 ^a	4.30%	9 ^a	3.80%
	Very good	28 ^a	11.90%	35 ^a	14.90%
	Good	56 ^a	23.80%	60 ^a	25.50%
	Not too bad	18 ^a	7.70%	14 ^a	6.00%
	Bad	1 ^a	0.40%	4 ^a	1.70%
Mental health	Excellent	12 ^a	5.10%	10 ^a	4.30%
	Very good	29 ^a	12.30%	40 ^a	17.00%
	Good	47 ^a	20.00%	50 ^a	21.30%
	Not too bad	21 ^a	8.90%	19 ^a	8.10%
	Bad	4 ^a	1.70%	3 ^a	1.30%
Sport practice	Yes	41 ^a	18.14%	44 ^a	19.47%
	No	64 ^a	28.32%	77 ^a	34.07%
Critical worker	Yes	43 ^a	32.57%	40 ^a	32.52%
	No	89 ^a	67.42%	83 ^a	67.48%
Smoker	Yes	46 ^a	19.66%	32 ^b	13.68%
	No. former smoker	24 ^a	10.26%	33 ^a	14.10%
	No. never	43 ^a	18.38%	56 ^a	23.93%

Values in the same row and subtable not sharing the same subscript are significantly different at $p < 0.05$ in the two-sided test of equality for column proportions. Cells with no subscript are not included in the test. Tests assume equal variances. Tests are adjusted for all pairwise comparisons within a row of each innermost subtable using the Bonferroni correction.

are called General Distress (equivalent to NA), Anhedonic Depression (equivalent to PA), and Anxious Arousal (equivalent to SA). The dependent variable in this study is Distress, which encompasses general symptoms of psychological Distress; that is, unpleasant feelings or emotions that can hinder people’s daily lives and affect the way one reacts to the people around them, especially when they feel overwhelmed. For this specific research, General Distress will be understood as the Generalized

Least Squares (GLS) factor value, taken by maximum likelihood (ML), of Distress items obtained from each participant's answers collected in the MASQE-30 daily register. The factorial variable Distress has a mean equal to 0, and a standard deviation of 1.225.

In addition, the daily records included questions about whether the participants had carried out work-related tasks in their homes using telecommuting that day (0 = not telecommuting and 1 = telecommuting that day); if they had practiced some kind of physical activity at home or in the building lasting more than 15 min (0 = had not practiced physical activity and 1 = had practiced physical activity that certain day); if during the day they had carried out sexual activity, regardless of whether it has been alone or accompanied (0 = did not have sexual activity and 1 = had sexual activity that day); if they had spent more than 15 min listening to music (0 = did not listen to music and 1 = listened to music that day). The effects of the levels of Distress perceived on previous days and some interactions between gender and those variables were considered (Yip and Tsang, 2007; Rosel et al., 2014).

Procedure

The first step of this process was to create the online questionnaire using the platform interface of Qualtrics. Thanks to this application, we could automatically register the date and time at which the participant had completed the registration. In order to reduce the experimental mortality, a daily email was sent to the participants to remind them to complete the daily questionnaire. If the diary log was not answered, the next morning at 9:00 h an automatic reminder was sent to complete it.

All participants were recruited voluntarily through social media (web forums, WhatsApp, Twitter, and Facebook) along with a brief explanation of the study. The link to the socio-demographic survey was included. An email address was requested so that the participants could receive access to the daily diary. Once the first sociodemographic poll had been completed, the email containing the diary was sent toward the end of the day (20:30 h) to the participant's email addresses. The diary was completed daily during the lockdown period. No specific conditions were required for the final sample to participate besides being adults (only adults over 18 years of age could participate in this study). All participants were living in Spain at the time of the lockdown and had access to the Internet.

The collected data were analyzed using the statistic procedure of lineal mixed-effects modeling in SPSS (2020). It is a multilevel model in which Level 1 is each measured variable, and Level 2 is each individual, that is, the respective measurements are nested within each individual (Gill, 2005; Goldstein, 2010). The model estimation and factor analysis were done with ML extraction. The general regression equation can be decomposed into the corresponding equation for each group (male/female), and because the variable gender has two levels (groups) we can obtain a different equation for males and females that represents the perceived Distress (Yip and Tsang, 2007; Rosel et al., 2014; Hayes and Montoya, 2017).

To measure Distress memory, first the configuration of the data has been changed from individual per line to data-day per line (Singer and Willett, 2003), and then the stabilized Distress

variable has been delayed up to 14 days in each participant, with the precautions to be taken in the pooled time series 256 models (Sayrs, 1989; Andreß et al., 2013; Rosel et al., 2019). Furthermore, when time series data are used, it is assumed that serial correlation exists, which means that a person's mean Distress level of that day will affect their mean Distress level of the next day/s.

According to Box and Jenkins (1976) recommendations for time series analysis, when a time series doesn't keep stability in its mean, differentiation would be recommended. If we observe **Figure 1**, the mean of Distress is higher at the beginning of confinement and tends to decrease over time and slowly stabilize. However, if the differentiation procedure is followed, the dynamic properties of the time series are lost in the long term (Huckfeldt et al., 1982; Engle and Granger, 1987). The decreasing Distress can be formalized through the reciprocal function ($1/t$), where "t" is the number of days elapsed since confinement. Function $1/t$ has been taken as the stabilization variable of the series due to its simplicity and because it presents great flexibility when adjusting curves with an initial rapid decrease (or increase), later presenting an asymptotic stable almost horizontal trend. The following regression has been made:

$$Distress_t = b_0 + b_1 \left(\frac{1}{t} \right) + \varepsilon_t \quad (2)$$

Where ε_t is the part of the Distress factor not explained by the reciprocal function in Equation 1, which is now stationary in the mean. The values of ε_t will be called stabilized Distress. The stabilized (ε_t) model is a multilevel model as each individual represents a different level. Equation 1 has not been calculated in a multilevel way to allow general Equation 3 to capture the possible multilevel relationship between the intercept and the DV. The mentioned model includes an analysis of principle fixed effects of Distress, the effect of previous days (lags), and the effect of different variables considered in the design (telecommuting, housework, physical activity, sexual activity, listening to music). Interactions between gender and the variables mentioned before were considered, and the Level 2 of the intercept, each individual.

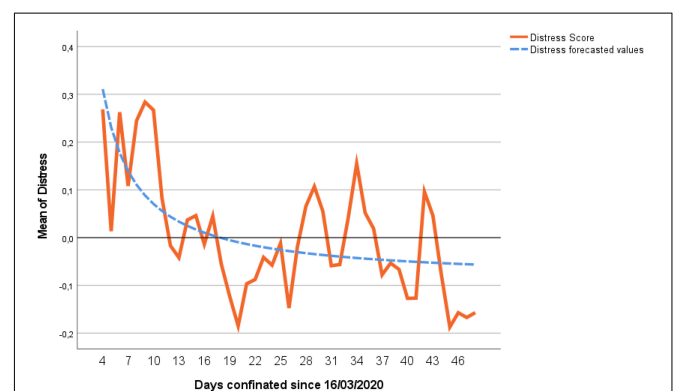


FIGURE 1 | Mean values of Distress for all the sample and predicted values obtained by Equation 2.

Ethical Standards

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. The Deontological Commission of the Jaume I University has issued a favorable report on the project with file number CD / 24/2020: “Mood evolution during confinement due to COVID-19 in Spain,” considering that it complies with the deontological regulations required.

RESULTS

A significance level has been taken for the results of 5% ($\alpha = 0.05$). The following consistency statistics were observed: Cronbach's $\alpha = 0.983$; Intraclass Correlation (ICC) for single measures = 0.568 (47, 2,068), $p < 0.001$; ICC for average measures = 0.983 (47, 2,068), $p < 0.001$. The statistics Partial Eta Squared (η^2), Non-centrality Parameter (δ), and Observed Power ($1-\beta$) are also indicated. The Distress score in function of the variable “1/time” (Equation 1) was statistically significant ($F = 16.270$; df : 1, 4,854; $p < 0.001$; $\eta^2 = 0.003$; $\delta = 16.270$; $1-\beta = 0.981$), obtaining the coefficients:

$$\text{Distress}_t = -0.090 + 1.604 \left(\frac{1}{t} \right) + \varepsilon_t \quad (3)$$

We can see in **Figure 1** how the trend of the series is well represented in the predicted values obtained in Equation 3, superimposing these predicted values to those obtained empirically by the sample. One of the objectives of this study was to assess the magnitude and duration of the influence of confinement on people's Distress. Although the first 3 days from the start of the lockdown could not be measured, it is observed that the maximum Distress took place during the first 7 days measured (days 4–10 after lockdown), as the mean of these days is equal to 0.211 ($SD = 1.355$). Taking as a reference the last 10 days of confinement, the data closest to the possible “normality” (**Figure 1**) because they are the ones that will most resemble in level and variability to the data of a normal period, the sample has had a Distress $M = -0.089$, and $SD = 1.117$. Because the data have two levels, a comparison of means (Student's t -test) was made with bootstrap with the criterion of stratification per participant (level 2) with 1,000 subsamples (Pons, 2007; Wu and Thompson, 2020), giving a value of $p(t) = 0.001$, bias = -0.001 , Cohen's $d = -0.247$, 95% CI $[(-0.414) \text{ to } (-0.200)]$. Therefore, the difference in the level of anxiety from the beginning of the pandemic to that of the end is significant. The bootstrap system does not give a value of t but, under normal conditions and $p(t) = 0.001$, corresponds a $t^* = 3.301$, which indicates that at the beginning of the pandemic our sample suffered very high levels of Distress, approximately 3.301 scores typified in relation to the distress suffered at the end. As we have a very large sample, the values of t are equivalent to the values of z .

The values of these forecast errors are the part of the Distress factor not explained by the reciprocal function of “ t ” in Equation 1, so these values of ε_t will be called Stabilized Distress (ε_t).

Then, considering only the stabilized Distress, we can represent it graphically as in **Figure 2**, which is now already stationary on average, and it is what we will use as DV from now on to forecast the stabilized Distress in Equation 1.

An exploratory analysis of stabilized Distress has been made, and it has been verified that there are quite a few significant lags in the ACF and PACF, in addition to the Box-Ljung statistic having a value for 14 lags of 22785.740, df : 14, $p < 0.001$. So, the data of the series are not “white noise,” presenting serial dependence, and must be modeled using time series with the variables presented in the hypothesis. Given that our hypothesis on the lags is autoregressive, so that more recent lags will influence more than the older ones, the non-significant intermediate lags have been maintained as indicated by Box et al. (2016); delays 7 and 14 are maintained, since we see that the behavior presents a seasonality of 7 days. We have suppressed the variables Lag 1 stabilized Distress Gender ($b = 0.002$, $SE = 0.023$, $p = 0.934$), Age ($b = -0.001$, $SE = 0.001$, $p = 0.174$), and the Listening interaction music Gender ($b = 0.101$, $SE = 0.054$, $p = 0.062$) because they are not statistically significant. The final stabilized model can be observed in **Table 2**.

There is no significant Level 2 inter-subject differences (intercept, $\text{Var}[b_{0k}] = 0.000$), which means that all subjects present the same intercept of Distress but not all individuals present the same level in the values obtained in the delays and in the variables included in the equation.

In order to test the significance of the total fit of the equation in **Table 2**, the value of its -2 logarithm of the likelihood ($-2LL$) is compared with its respective parameters ($-2LL = 6396.565$; parameters: 21), with that of the null model, only with the intercept of the series ($-2LL_0 = 15737.478$; parameters: 2), being the increment of values: $\Delta(-2LL) = 9340.913$, and $\Delta(df) = 19$, which follows a chi-squared distribution, so the fit of the model of the equation in **Table 2** has a $p < 0.001$, the overall fit being significant. The R^2 -value is 0.663 ($p < 0.001$), so approximately 66% of the variance of Distress is explained by the equation resulting from the variables included in **Table 2**.

Table 2 shows that the variables related to physical activity (Physical Activity and Physical Activity Gender) are not significant, but when we have removed them from the final equation, their Akaike information criteria (AIC) has passed

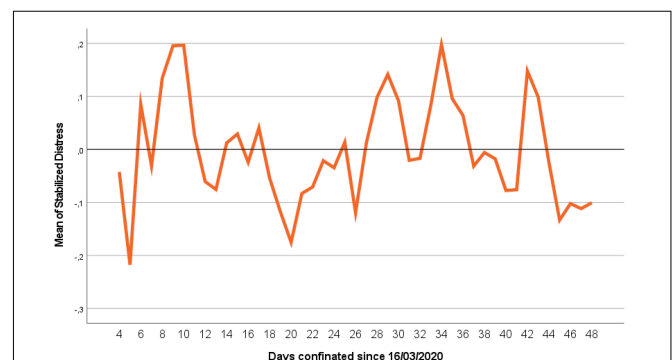


FIGURE 2 | Stabilized values of Distress for all the samples.

TABLE 2 | Estimates of fixed effects included in the final stabilized model of distress during lockdown.

Parameter	Estimate	Std. Error	t	p	η^2	δ	1- β
Intercept	0.040	0.030	1.312	0.190	0.001	1.303	0.256
Lag 1 stabilized distress	0.313	0.018	17.607	0.000	0.090	17.579	1.000
Lag 2 stabilized distress	0.106	0.018	5.777	0.000	0.011	5.816	1.000
Lag 3 stabilized distress	0.031	0.018	1.656	0.098	0.001	1.677	0.388
Lag 4 stabilized distress	0.073	0.018	3.992	0.000	0.005	3.952	0.977
Lag 5 stabilized distress	0.100	0.018	5.490	0.000	0.009	5.456	1.000
Lag 6 stabilized distress	0.080	0.018	4.432	0.000	0.006	4.377	0.992
Lag 7 stabilized distress	0.064	0.018	3.488	0.000	0.004	3.495	0.938
Lag 8 stabilized distress	0.019	0.018	1.070	0.285	0.000	1.097	0.195
Lag 9 stabilized distress	0.022	0.018	1.227	0.220	0.000	1.217	0.229
Lag 10 stabilized distress	0.051	0.017	2.960	0.003	0.003	2.948	0.838
Lag 14 stabilized distress	0.049	0.015	3.276	0.001	0.003	3.225	0.897
Telecommuting	0.088	0.046	1.895	0.058	0.001	1.884	0.469
Physical activity	0.013	0.050	0.251	0.802	0.000	0.248	0.057
Sexual activity	-0.127	0.039	-3.236	0.001	0.003	3.222	0.896
Listen to music	-0.092	0.025	-3.712	0.000	0.004	3.683	0.957
Gender	0.079	0.034	2.309	0.021	0.002	2.283	0.627
Telecommuting · Gender	-0.156	0.056	-2.786	0.005	0.002	2.766	0.790
Physical activity · Gender	-0.113	0.060	-1.903	0.057	0.001	1.888	0.471

Dependent variable: Stabilized distress. η^2 , Partial Eta Squared; δ , Non-cent. Parameter; 1- β : Observed Power.

from 6396.565 with these 2 variables (model in **Table 2**) to 6406.272, so apparently the model with physical activity is better than without it. We have verified if this improvement is statistically significant by comparing their respective $-2LL$, where the $-2LL = 6392.467$ for the model without Physical Activity and Physical Activity Gender, so $\Delta(-2LL) = 6406.272 - 6396.565 = 9.707$, $\Delta(df) = 21 - 19 = 2$, $p = 0.008$, so the difference is significant in favor of the model with the physical activity variables in **Table 2**. In other words, although the Physical Activity and Physical Activity Gender variables are not significant separately, when their overall probability is calculated, it is significant, so we leave them in the final Equation of **Table 2**.

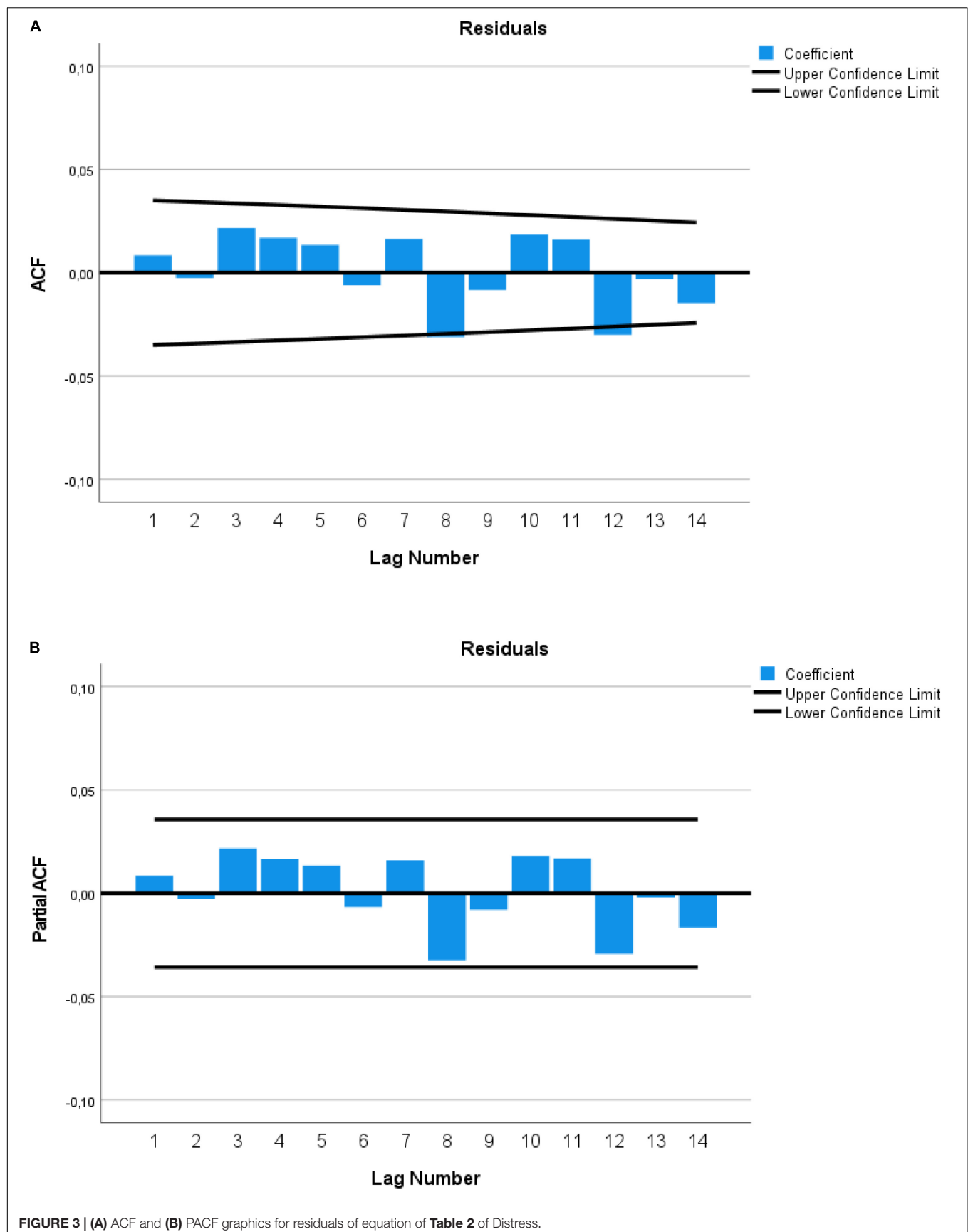
Finally, the study of the model residuals is carried out to determine if they constitute white noise. As we can see in the ACF and PACF (**Figures 3A,B**), we can determine that the time series for Stabilized Distress is correctly modeled, including the first 10 lags and the 14th lag, as well as a group of variables that contribute to the explanation of the Distress score (Box-Ljung statistic for 14 lags of 19.808, $df: 14$, $p = 0.136$). In **Figure 2A**, delays 8 and 12 are at the limit of significance, but bear in mind that for a delay to be significant it must be in its ACF and its PACF, and since they are not significant delays 8 and 12 of **Figure 2B**, nor the result of the Box-Ljung test, the residuals constitute a “white noise.” In Box-Jenkins terms, the model has a memory of 10 simple days plus a seasonality of 7 days over 2 weeks, that is, it is an ARIMA(10,0,0) (2,0,0)₇ model. This check is very important from a statistical perspective, because it indicates that the coefficients obtained are not biased and their standard errors are consistent, avoiding type I errors (Kmenta, 1971). That is, the effects obtained are significantly so in reality. In summary, since the overall fit of the model is significant, and the residuals are “white noise,” we accept the model from **Table 2**.

Turning now to the next part of the results of the model proposed shown in **Table 2**, interactions between gender and some variables can be highlighted. Developing Stabilized Distress (ε_{ik}), according to **Table 2**:

$$\begin{aligned} \varepsilon_{ik} = & 0.040 + 0.313 \cdot StD_{t-1} + 0.106 \cdot StD_{t-2} + 0.031 \cdot StD_{t-3} \\ & + 0.073 \cdot StD_{t-4} + 0.100 \cdot StD_{t-5} + 0.080 \cdot StD_{t-6} \\ & + 0.064 \cdot StD_{t-7} + 0.019 \cdot StD_{t-8} + 0.022 \cdot StD_{t-9} \\ & + 0.051 \cdot StD_{t-10} + 0.049 \cdot StD_{t-14} + [0.088 \cdot Telecommuting \\ & - 0.156 \cdot Telecommuting \cdot Gender] - 0.127 \cdot SexualActivity \\ & - 0.092 \cdot Listen\ to\ music + [0.013 \cdot Physical\ Activity \\ & - 0.113 \cdot Physical\ Activity \cdot Gender] + 0.079 \cdot Gender + \varepsilon_{ik}' \quad (4) \end{aligned}$$

In **Table 2** it can be seen that the delays 3, 8, and 9 of the Stabilized Distress variable are not significant, but they have been included due to the fact that the subsequent delays are significant, that is, delay 4 and delay 10 (Box et al., 2016). Note how all the autoregressive coefficients are positive, which is consistent with the expected behavior of any individual, so that if Distress increases on any given day, stress will tend to increase in subsequent days.

Previously it has been explained why Physical Activity and Physical Activity Gender have been included, but it can also be seen that there is a simple variable, Telecommuting, that is not significant and has been kept in the equation. This is because it is part of a significant interaction (Telecommuting Gender), so it must be maintained due to the principle of “nesting” in the interaction of variables. An important aspect to take into account is that when the interaction of gender with another variable is significant, the coefficient of that variable is different



for men and women (Hayes and Montoya, 2017). Thus, the interaction of the Physical Activity and Telecommuting variables by gender indicates that both variables affect men differently than women in terms of their effect on Distress. Specifically, due to its negative sign and the Gender values being 0 for male and 1 for female, we can affirm that both variables reduce the perceived Distress in women.

Considering that in Equation 3, ε_{tk} is a part of Distress indicated in Equation 2, we can substitute ε_{tk} from Equation 4 in Equation 3:

$$\begin{aligned} \text{Distress}_{tk} &= -0.090 + 1.604 \left(\frac{1}{t} \right) + \{\varepsilon_t\} \\ &= -0.090 + 1.604(1/t) + \{0.040 + 0.313 \cdot \text{StD}_{t-1} \\ &\quad + 0.106 \cdot \text{StD}_{t-2} + 0.031 \cdot \text{StD}_{t-3} + 0.073 \cdot \text{StD}_{t-4} \\ &\quad + 0.100 \cdot \text{StD}_{t-5} + 0.080 \cdot \text{StD}_{t-6} + 0.064 \cdot \text{StD}_{t-7} \\ &\quad + 0.019 \cdot \text{StD}_{t-8} + 0.022 \cdot \text{StD}_{t-9} + 0.051 \cdot \text{StD}_{t-10} \\ &\quad + 0.049 \cdot \text{StD}_{t-14} + [0.088 \cdot \text{Telecommuting} \\ &\quad - 0.156 \cdot \text{Telecommuting} \cdot \text{Gender}] - 0.127 \cdot \text{SexualActivity} \\ &\quad - 0.092 \cdot \text{Listen to music} + [0.013 \cdot \text{Physical Activity} \\ &\quad - 0.113 \cdot \text{Sport} \cdot \text{Physical Activity}] + 0.079 \cdot \text{Gender} + \varepsilon_{tk}' \end{aligned} \quad (5)$$

The final Equation 5 can be developed in two different equations for men and for women. Therefore, because it has been coded with the value of “0” for men and “1” for women, Equation 2 is substituted and simplified for each gender, and each corresponding interaction is replaced by its result, as follows:

$$\begin{aligned} \text{Distress}_{\text{Male}_{tk}} &= 0.050 + 1.604 \cdot \left(\frac{1}{t} \right) + 0.313 \cdot \text{StD}_{t-1} \\ &\quad + 0.106 \cdot \text{StD}_{t-2} + 0.031 \cdot \text{StD}_{t-3} + 0.073 \cdot \text{StD}_{t-4} \\ &\quad + 0.100 \cdot \text{StD}_{t-5} + 0.080 \cdot \text{StD}_{t-6} + 0.064 \cdot \text{StD}_{t-7} \\ &\quad + 0.019 \cdot \text{StD}_{t-8} + 0.022 \cdot \text{StD}_{t-9} + 0.051 \cdot \text{StD}_{t-10} \\ &\quad + 0.049 \cdot \text{StD}_{t-14} + 0.088 \cdot \text{Telecommuting} \\ &\quad - 0.127 \cdot \text{SexualActivity} - 0.092 \cdot \text{Listen to music} \\ &\quad + 0.013 \cdot \text{Physical Activity} + \varepsilon_{tk}' \end{aligned} \quad (6)$$

$$\begin{aligned} \text{Distress}_{\text{Fem}_{tk}} &= 0.029 + 1.604 \cdot \left(\frac{1}{t} \right) + 0.313 \cdot \text{StD}_{t-1} \\ &\quad + 0.106 \cdot \text{StD}_{t-2} + 0.031 \cdot \text{StD}_{t-3} + 0.073 \cdot \text{StD}_{t-4} \\ &\quad + 0.100 \cdot \text{StD}_{t-5} + 0.080 \cdot \text{StD}_{t-6} + 0.064 \cdot \text{StD}_{t-7} \\ &\quad + 0.019 \cdot \text{StD}_{t-8} + 0.022 \cdot \text{StD}_{t-9} + 0.051 \cdot \text{StD}_{t-10} \\ &\quad + 0.049 \cdot \text{StD}_{t-14} - 0.068 \cdot \text{Telecommuting} \\ &\quad - 0.127 \cdot \text{SexualActivity} - 0.092 \cdot \text{Listen to music} \\ &\quad - 0.100 \cdot \text{Physical Activity} + \varepsilon_{tk}' \end{aligned} \quad (7)$$

We can observe different values of the intercept for men (0.050) and for women (0.029). This is because in men (Equation 6) it is the result of the sum of the intercepts of Equation 3 (−0.090)

and Equation 4 (0.040); while in women (Equation 7) it is the previous result plus the value of $0.079 \cdot \text{Gender} = 0.079$, being the result of $0.090 + 0.040 + 0.079 = 0.029$. In the same Equations 6 and 7 the effect of $1/t$ is significant ($b = 1.604$); this indicates that when the time from confinement increases, its effect on Distress decreases until it approaches the value of −0.090 (Distress baseline determined by the intercept of Equation 3). Initial values of Stress are very high, but they decrease gradually, rapidly in the beginning, and more slowly from day 30 (**Figure 1**). This can be seen with an example: in the case of keeping all the other variables of the Equation 5 constant, on the first day of confinement ($t = 1$) the increase in Distress will be 1.604 points; on the 15th day of confinement ($t = 15$), the increase in Distress due time was: $1.604 \cdot (1/15) = 0.107$; on the 30th day of confinement ($t = 30$), the increase in Distress due time was: $1.604 \cdot (1/30) = 0.053$; on the last day of lockdown, the increase in Distress was 0.033 [$1.604 \cdot (1/30)$] verifying that when t increases, $1/t$ approaches the value 0.

The proposed model has significant delays up to 14 days, which indicates that during the lockdown the “memory” of Distress has been 2 weeks (Box and Jenkins, 1976). The term $0.313 \cdot \text{StD}_{t-1}$ in the equation means that if 1 day any person’s Distress increases by one unit, the next day their Distress increases by 0.313 units. In the same way, $0.106 \cdot \text{StD}_{t-2}$ indicates that for each unit of increase in Distress, after 2 days Distress will increase by 0.106 units, and so on until the 14th delay was reached, when term $0.049 \cdot \text{StD}_{t-14}$ indicates that an increase in one unit of Distress would produce an increase of 0.049 units of Distress after 14 days.

Regarding the term $[0.088 \cdot \text{Telecommuting} - 0.156 \cdot \text{Telecommuting} \cdot \text{Gender}]$ of Equation 5, as the Telecommuting·Gender interaction was significant ($p = 0.005$), the simple variables telecommuting and gender have also been left, resulting for men: $0.088 \cdot \text{Telecommuting} - 0.156 \cdot \text{Telecommuting} \cdot 0 = 0.088 \cdot \text{Telecommuting}$; and for women: $0.088 \cdot \text{Telecommuting} - 0.156 \cdot \text{Telecommuting} \cdot 1 = -0.068 \cdot \text{Telecommuting}$ (Equations 6 and 7). Therefore, the coefficients are different for men and women: in men, the fact of teleworking increases Distress by 0.088 units, while in women it decreases by 0.068 units. The gender coefficient value (0.079) is not included because it has already been incorporated before, and it must be included only once in Equation 7.

Regarding the variable “Sexual Activity” ($b = -0.127$, $p < 0.001$), the practice of sexual activity reduces distress for a day by 0.127 units, and this occurs in both men and women.

We also observe in **Table 2** that the Physical Activity·Gender interaction has been no significant ($b = -0.113$, $p = 0.057$), being the value of its interaction ($0.013 \cdot \text{Physical Activity} - 0.113 \cdot \text{Physical Activity} \cdot \text{Gender}$), plus the effect of gender, which has already been included (Equations 6 and 7). This would indicate that Physical Activity practice affects distress differently depending on gender, although the practice of physical activity as a principal variable is not significant ($b = 0.013$, $p = 0.802$), as seen in **Table 2**. Therefore, in the case of men: $0.013 \cdot \text{Physical Activity} - 0.113 \cdot \text{Physical Activity} \cdot 0 = 0.013 \cdot \text{Physical Activity}$, which would indicate that the practice of physical activity increases distress in men by 0.013 points (although this value in itself is not significant, it is maintained because

together with Physical Activity it is significant). On the other hand, in women, $0.013 \cdot \text{Physical Activity} - 0.113 \cdot \text{Physical Activity} \cdot 1 = -0.100$, which means that the practice of physical activity reduces distress in women by 0.100, with significant differences between men and women.

Finally, the observed power ($1-\beta$) of the variables has been calculated, the lowest being that of the Physical Activity variable ($1-\beta = 0.057$), although the interaction of Physical Activity and Gender is higher ($\beta = 0.471$), and its coefficient is not significant ($b = -0.113$, $p = 0.057$). Possibly it would be convenient to expand the sample, but if we take into account that both variables together ($p = 0.008$) then the sample size is adequate. That is, the power of the Physical Activity variable is associated with that of the Gender variable and the interaction of both variables. The highest power has been achieved in the variable StD_{t-1} ($\beta = 1.000$), together with $1/t$ ($\beta = 0.981$), so that the temporary variables have great power, making our sample sufficiently representative for robust effect parameters.

DISCUSSION

Distress, as well as other variables that can have a negative impact on a person's well-being, have been studied in other countries, and results tend to agree on the importance of focusing on the population's psychological and emotional well-being and thus highlighting mental health as a protection factor in future lockdown situations that could take place. Moreover, some variables that can act as protective factors are importantly studied in order to prevent negative consequences in extreme situations such as compulsory lockdown or any other situations where adaptation is necessary, in order to increase the efficiency of coping strategies and resilience. One of the main goals of the current study was to analyze and explore the effects of daily activities on Distress levels and fluctuations during the COVID-19 pandemic lockdown in Spain. Taken together, these findings suggest the importance for public health to apply measures on wellbeing.

These findings broadly support the work of other studies in Distress that link its gradual reduction with the maintenance of the situation over time. In this sense, we can observe that in the first days of the confinement a high level of Distress is observed, decreasing rapidly in the following days, and more slowly in the final periods of the lockdown (**Figure 1**). As an interesting detail, it should be noted that on days 20, 34, and 49 from the beginning of the closure, extensions of the state of alarm were approved in the council of ministers, although the media gave the news of the extension proposals 4–5 days before. These approvals and notifications coincide closely with abrupt increases in the level of Distress of the subjects studied. These increases in distress in the face of the extensions of the confinement are logical, since the perceived insecurity about the development of the pandemic, the economic and labor consequences both for oneself and for their acquaintances and relatives, the perception of the risk of contagion and serious course of the disease, and the length of the confinement itself are the main causes of perception of insecurity and distress.

An important finding to take into account is that if the Distress of our sample is taken during the first 7 days of our investigation (from the fourth day of confinement), and it is compared with the mean Distress during the last 10 days of confinement (with a lower mean Distress, and supposedly more similar to Distress under normal conditions), then the z -value (standardized score) increased by 3.301 points ($p = 0.001$), which indicates that the participants endured a very high level of Distress. If this comparison were made with a sample during a normal unconfined phase, this value of z would probably increase.

Other significant finding to emerge from this study is that during the lockdown, the “memory” of Distress has been 2 weeks, resulting in a significant inertia within each person where no differences are observed between people in the process generation of Distress, because the Level 2 coefficient is not significant. Overall, these results indicate that levels of Distress also depend on the activities that a person did during lockdown. In addition, interaction exists between gender and some behavioral variables. This means that a woman who did some of the activities mentioned during the day would show a different level of Distress compared to a person who did not do these activities, making the differences statistically significant.

Thus, there are different behavior variables like Telecommuting, which increases Distress in men by 0.088 points, but decreases 0.068 in women; or Physical Activity, which increases Distress 0.013 points in men but decreases Distress by 0.100 points in women. Comparing the results, women were generally positively influenced by telecommuting and practicing physical activity more than men. Having sexual activity influences positively both genders.

Significant statistical differences were found when considering Distress as a function of lag 1, lag 2, lag 4 to lag 7, lag 10, and lag 14. The results of this investigation show that, during lockdown, people's Distress levels from previous days influenced the Distress levels of that day, which meant that what happened today will affect your Distress levels up to 14 days later, but the effect is higher during the two following days, with the biggest values of lag coefficients. Furthermore, females had, overall, higher Distress levels during the COVID lockdown. A total of 56.25% ($n = 72$) of the participants telecommuted, and Distress levels in men were higher compared to those participants who did not telecommute, but in women this activity decreased Distress. Having sexual activity reduced Distress levels in general, with no effect differences being male or female. Furthermore, music is a protective factor for both men and women in keeping Distress levels lower. Age did not influence the level of Distress experienced by the sample. Focusing on levels of Distress in women as compared to men, doing daily physical activity reduced their daily perceived levels of Distress, proving the importance for women of doing daily activities to reduce Distress levels. This study proves that gender differences must be considered in order to analyze correctly analyze lockdown data.

It is interesting to note that the general intercept b_0 , was estimated as a fixed effect and as a random effect (individual effect Level 2 variable) but this last one did not show significant statistical differences. This discrepancy could be attributed to a

large time memory of 14 days, with 11 autoregressive terms, from StD_{t-1} to StD_{t-10} including StD_{t-14} . These 11 terms reflect every person's distress level, thus high levels of StD_{t-1} to StD_{t-14} will forecast high levels of the dependent variable Distress, not being necessary to reflect it in a Level 2 intercept variability. Therefore, the fact that our individuals have a common intercept does not mean that they also have the same level of Distress, since their daily level is conditioned by the levels of the previous 14 days.

It might seem that the main weakness of this study was the number of observations registered per participant when considering a time series. According to Box et al. (2016, p. 31) “to obtain a useful estimate of the autocorrelation function in practice, we would typically need at least 50 observations” but having used a pooled time series or panel data system, the statistical power is much higher (Baltagi, 2005). However, our research findings show that the time variables had higher statistical power than cross-sectional variables, and we consider that our sample has sufficient statistical power to assume that it includes a sufficient number of participants. The strict confinement in Spain lasted 48 days, then, the de-escalation period began, allowing certain confinement relief measures at different stages. In addition, a daily record is difficult for the participants to follow, which means that there were omissions in the completion of several consecutive days, in approximately 2/3 of the subjects or that they completed less than 20 days, proceeding to their elimination of the study sample. Future research could usefully consider in-depth analysis to study the temporary process in order to analyze the trajectories and changes of the main variable over time. It is probable that the autoregressive effects and the effects of the significant variables in other situations will be very similar to those found during confinement. Probably, the behavior of individuals during a period of “normality” without a pandemic will show lower levels of distress and less variability.

The sample of participants used has been made up of volunteers and unpaid people, so there are variables that are not sampled in a “balanced” manner (gender, age, telecommuting, if they practice regular physical activity,...) and, therefore, it could be argued that it is not sociologically representative. On the other hand, it has the advantage that it presents ecological representativeness, since it is assumed that the process of distress change has been very similar in our sample and in the general population. In addition, without forgetting the sample representativeness, special attention has to be paid to the representativeness of the process studied in the research carried out (Brunswick, 1956; Bordalo et al., 2021). More studies are needed to see if the psychological effects of Distress during the pandemic have been short-lived or if they have a longer-term effect.

The high levels of Distress suffered by our sample suggest that some type of support system should be considered for successive occasions. At the end of the confinement, it suggests that the population was subjected to a psychological pressure far above what is clinically normal. We hope that these high levels of Distress suffered at the beginning of the pandemic will not leave pathological traces in individuals. Faced with future

confinement situations, it would be necessary to have detection systems for people with a high level of Distress and have prepared intervention protocols to intervene individually in high-risk people (personal or social), and globally (through campaigns of awareness, establishment of routines, schedules, physical activity, hobbies, use of social networks and teleconferences, etc.) in the population.

In addition, computerized registration systems allow almost continuous data collection, as in the present investigation. Different variables have been collected over multiple days belonging to different individuals, which requires data analysis models appropriate to the system used, so it is expected that training in data-intensive analysis models using pooled time series and other techniques (multilevel analysis, resampling,...) will increase (Nusser et al., 2006; Bolger and Laurenceau, 2013; Walls, 2013; Rosel et al., 2020). So, future studies on the temporal processes of Distress should be carried out to check if its memory and the influential independent variables on Distress are similar during confinement and under non-confinement conditions, as in the “de-escalation” of lockdown limitations, and in periods of normality.

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 Deontological Commission of the Jaume I University with file number CD/24/2020: “Mood evolution during confinement due to COVID-19 in Spain”. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

PF-A: writing—original draft, data curation, formal analysis, and writing—review and editing. EF: supervision and writing—review and editing. JR: supervision, validation, formal analysis, and writing—review and editing. AB-L: supervision, validation, and writing—review and editing. FM: conceptualization, writing—original draft, formal analysis, and writing—review and editing. All authors contributed to the article and approved the submitted version.

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Hidden in Plain Sight? Men's Coping Patterns and Psychological Distress Before and During the COVID-19 Pandemic

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Individuals cope with stress using multiple strategies, yet studies of coping profiles are rare. We draw data from a longitudinal study of Australian men ($n = 272$; 30–37 years), assessed before (T1) and during (T2) a nation-wide COVID-19 lockdown. We aimed to: (1) identify men's multi-strategy coping profiles before and during the pandemic; (2) assess cross-sectional (T1-T1, T2-T2) and prospective (T1-T2) associations between profiles and symptoms of psychological distress (stress, anxiety, depression, and anger); and (3) examine relationships between coping profiles and appraisals of pandemic-related stressors and options for coping. In latent profile analyses of 14 coping strategies, three profiles emerged that were largely consistent across T1 and T2: (1) Relaxed Copers (low use of all strategies), (2) Approach Copers, and (3) Dual Copers (high avoidant and moderate-high approach-oriented strategies). Compared to Relaxed and Approach Copers, men who were Dual Copers had elevated psychological distress cross-sectionally before (T1) and during (T2) the pandemic, but not prospectively. *Post hoc* analyses suggested this was because many men changed coping profiles in the context of the pandemic. Men with stable (T1-T2) or new (T2 only) Dual Coping profiles experienced greater psychological distress and more negative appraisals of pandemic stressors and options for coping. In sum, at the sample level, the composition of men's coping profiles and associations with mental health risk were relatively stable over time and contexts; however, many men appeared to respond to pandemic conditions by changing coping profile groups, with mostly positive mental health outcomes. Of concern were men who adopted more avoidant strategies (e.g., denial, self-distraction, disengagement, substance use, and self-blame) under pandemic conditions. These Dual Coper men also engaged in commonly observable approach-oriented behaviours (e.g., planning, active coping, humour, seeking practical social support) that may mask their vulnerability to mental health risk. Our findings highlight the clinical importance of enquiring about escalating or frequent avoidant coping even in the presence of more active and interactive approach-oriented behaviours.

Keywords: men, coping, stress, anxiety, psychological distress, depression, COVID-19, pandemic

INTRODUCTION

Coping refers to cognitive and behavioural efforts to manage stressful situations or their implications [(1), p. 223]. Maladaptive coping patterns are linked to vulnerability and maintenance of psychopathology (2, 3). Prior research has predominantly taken variable-centred approaches that examine associations between individual coping strategies and mental health outcomes. Yet individual coping strategies are rarely used in isolation. Individual differences in the use of multiple strategies—referred to as coping repertoires or profiles—may more meaningfully reflect real-world responses to stress and vulnerability to psychopathology (4). Despite this, little is known about coping profiles and their relevance to psychological distress within populations under stress.

In the emerging research on coping profiles and psychopathology, samples predominantly span adolescence and young adulthood [e.g., (5–7)]. The few adult samples either represent specific subgroups [e.g., breast cancer or trauma survivors, low-income parents; (8–10)] or only report profiles extracted from mixed-gender samples [e.g., (11)]. Yet adult roles and gender norms influence individuals' exposure to stressors and their coping responses (12, 13). Here, we draw on rare longitudinal data to examine adult men's coping repertoires before and during the COVID-19 pandemic and their links with common symptoms of psychological distress (stress, anxiety, depression, and anger).

Prior studies identify links between men's use of avoidance, suppression, and denial with emotional dysregulation, aggression, substance use, and elevated mental health risk (12, 14–16). The picture is less clear regarding relationships between psychological distress and approach-oriented strategies that orient men toward stressors, such as planning, positive reframing, and acceptance. For these, there is mixed empirical support for the theoretically intuitive assumption that approach strategies are adaptive and associated with lower distress (15, 17, 18). Research focused on men's relative use of approach and avoidant coping strategies within their broader coping repertoires may help further understanding of links between coping and psychological distress.

Pre-pandemic research on coping profiles [e.g., (9–11)], and one niche study of French athletes during the pandemic (19) found more severe distress among individuals whose coping profile reflected higher reliance on avoidant relative to approach-oriented strategies. Similar to studies of individual coping strategies (20–22), there are inconsistent reports of associations between poor mental health and coping profiles differentially characterised by frequent approach-oriented coping strategies [e.g., seeking support vs. more independent problem solving; (19)].

One possible explanation is that gender effects in coping tendencies and associated mental health vulnerabilities lead to varying results across samples with differing ratios of men and women [e.g., (10, 11, 23, 24)]. Socialised responses to stress may be particularly pertinent during COVID-19, when strategies previously common in men's coping tendencies, such as active efforts to change the stressor, distraction, and denial

(13), may become less or more accessible or adaptive. Whether men's ways of coping with stressors during the pandemic are similar or different to their pre-pandemic coping repertoires and relations with psychological distress can be investigated only with longitudinal data.

Also relevant are cognitive appraisals of the personal threat, harm, or challenge presented by a stressor and perceived options available for coping (25). In combined gender samples, appraisals of pandemic-related stressors as personally threatening and uncontrollable have been negatively associated with approach-oriented coping strategies and positively associated with avoidant coping and symptoms of psychological distress (19, 20, 22, 26). Men's evaluations of what they can do to manage pandemic-related threats or harms may differ depending on the composition of their coping repertoire, particularly their relative reliance on avoidant coping (12), although this has yet to be tested.

Using data from a longitudinal study of men before and during Australia's first wave of COVID-19 infections, we aimed to examine: (1) coping profiles before and during the pandemic; (2) associations between profiles and psychological distress symptoms (stress, anxiety, depression, and anger); and (3) associations between coping profiles and cognitive appraisals of pandemic-related stressors and perceived options for coping.

MATERIALS AND METHODS

Sample

We used data from the Men and Parenting Pathways (MAPP) Study, an ongoing cohort study tracking the health and wellbeing of Australian men (27). Over two years beginning February 2015, MAPP recruited through social media, partner organisations, and word-of-mouth, 608 English-speaking men aged between 28 and 32 years, who were Australian residents, to complete an annual online survey for five years. The MAPP cohort is representative of the geographic spread of socio-economic advantage-disadvantage in Australia, the proportion of men who identify as Indigenous or Torres Strait Islander, and levels of high school education among Australian men of comparable age. MAPP participants are slightly more likely to be in paid employment. For further information about MAPP see Macdonald, Francis (27).

In March 2020, community transmission of the COVID-19 virus was detected in Australia and, by the end of the month, state and territory governments had closed non-essential industries and directed many Australians to stay home unless engaging in essential shopping, caregiving, work or study and limited exercise. The reduced economic activity led to rapid increases in unemployment and financial stress and the delivery of stimulus packages by the Australian Government. By the end of May 2020, community transmission appeared relatively suppressed (28).

In this study, timepoint one (T1) uses data collected from 409 men who completed the third annual MAPP survey between June 2017 and July 2019, prior to the emergence of COVID-19. There was no difference in key demographics of the sample that participated in the third annual survey and the sample at

recruitment and the ongoing MAPP cohort (27). Timepoint two (T2) data were collected from 286 ongoing MAPP participants who were invited via email to complete an online survey between 21 March and 19 May 2020 about the impacts of, and their responses to, the COVID-19 pandemic. The T2 sample excluded 14 men who responded to the COVID-19 survey but did not answer coping items ($n = 272$).

MAPP is approved by the Deakin University, Faculty of Health, Human Research Ethics Advisory Group.

Measures

Psychological Distress

At T1 and T2, stress, anxiety, and depressive symptoms were measured using the 21-item Depression Anxiety Stress Scale [DASS-21; (29, 30)]. For each 7-item subscale, participants indicated how frequently they had experienced symptoms during the past week on a 4-point scale from 0 (*Did not apply to me at all*) to 3 (*Applied to me very much or most of the time*). Total subscale scores were doubled for comparison with standardised norms for the 42-item DASS (*normal, mild, moderate, severe, very severe*) [normal, mild, moderate, severe, very severe; (30)]. State anger (i.e., present feelings and urges of anger) was measured because of its association with depression severity in men (16), including in MAPP participants (31). We used the 15-item state anger subscale of the state-trait anger expression inventory (STAXI-2; Spielberger, 1999). Participants rated the intensity of feelings and urges related to anger on a 4-point scale from 0 (*Not at all*) to 3 (*Very much so*). We used standardised population norms (32) to categorise scores as *normal* (0–75th percentile), *high* (75–95th percentile) and *very high* (95–100th percentile) anger intensity.

Coping Strategies

At T1 and T2, participants completed the 28-item Brief Cope (33) measuring how often they used 14 strategies (2 items per strategy subscale) to cope with stress on a 4-point scale from 1 (*I haven't been doing this at all*) to 4 (*I've been doing this a lot*). At T2, participants indicated how often they had been using each strategy since the beginning of the pandemic. Approach-oriented strategies were active coping, planning, positive reframing, acceptance, humour, emotional social support, instrumental social support, and venting. Avoidant strategies were denial, self-distraction, behavioural disengagement, substance use, and self-blame. Religious coping (e.g., praying) was not conceptualised as avoidant or approach-oriented, consistent with factor analytic studies in which religious coping failed to load on factors representing either orientation (34, 35).

Cognitive Appraisals

At T2, cognitive appraisals of the personal meaning of pandemic stressors were assessed using items adapted from the Cognitive Appraisal Health Scale (36). Participants rated their agreement on a 5-point scale from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*) with 4 items measuring perceived threat (e.g., “*I worry what will happen to me because of COVID-19*”), 4 items measuring perceived harm and loss (e.g., “*I have a sense of loss over things I can no longer do*”), and 3 items measuring perceived ability to overcome challenges to well-being (e.g., “*I can beat the effects of*

COVID-19 despite the difficulties”). On the same 5-point scale, participants rated four options for coping with pandemic life effects: (1) could alter something about the situation, (2) had to accept the situation, (3) needed to wait for more information before acting, and (4) had to refrain from preferred way of coping, as per Folkman et al. (37).

Potential Confounders

Potential confounders included T1 education level (year 12 or below, trade certificate to advanced diploma, university degree), relationship status, and T1 or T2 subjective financial stress. T1 psychological symptoms were adjusted for in longitudinal and T2 cross-sectional analyses. Confounders used in each analysis are detailed in the Regression Analyses section.

Analyses

Latent Profile Analyses

We used LPA, a person-centred analytic method, to identify classes of men who differ in their patterns of use of 14 coping strategies at T1 and T2. At T1 we first estimated classes using data from all men who participated in the third annual MAPP survey. We then estimated the class solution again at T1 using the subsample of men who later participated in the COVID-19 survey to assess whether classes were consistent and not an artefact of participation bias. LPAs were completed in Mplus version 8.4 (38). Missingness in coping subscales was addressed using full information maximum likelihood during the LPA (39). Two, three, four, and five-class models were estimated at T1. Two and three-class models were estimated at T2 (four and five-class models were not estimable). Model fit was assessed using the Akaike Information Criterion [AIC; (40)], sample-size adjusted Bayesian Information Criterion [aBIC; (41)], Vuong-Lo-Mendell-Rubin Likelihood Ratio Test (VLMR), and the Lo-Mendell-Rubin Adjusted Likelihood Ratio Test [LMR; (42)]. Entropy values indicated class classification accuracy (43). High entropy/classification accuracy (>0.80) enabled us to use participant's coping class membership in the optimal class model at each time point as categorical variables in regression analyses (44).

Regression Analyses

Generalised estimating equations were used to assess means and changes in psychological distress variables across T1 and T2. Multiple linear regression (MLR) analyses were used to examine whether coping profiles predicted concurrent and subsequent symptoms of stress, anxiety, depression, and anger at T1 and T2. For each form of psychological distress, a series of MLRs were estimated both unadjusted and adjusted for covariates. In T1 cross-sectional analyses (T1-T1), potential confounders were relationship status, education level, and financial stress assessed at T1. These confounders plus T1 psychological distress were also used in longitudinal analyses predicting T2 distress from T1 coping profiles (T1-T2). In T2 cross-sectional analyses (T2-T2), potential confounders were T1 psychological distress, relationship status, education level, and T2 financial stress. Finally, we used MLR to examine unadjusted associations between T1 and T2 coping profiles and coping appraisals.

TABLE 1 | Sample characteristics.

	T1		T2		T1 vs. T2	
	% M	95% CI	% M	95% CI	d_{av}	95% CI
ATSI	1.47	0.00, 2.91				
In a relationship	83.40	78.79, 88.01				
Education level						
≤High school	16.91	12.44, 21.39				
Trade Cert. -Adv. Diploma	33.82	28.18, 39.47				
University	49.26	43.30, 55.23				
Paid employment	97.06	95.04, 99.08				
Financial stress						
Comfortable	24.78	19.41, 30.15	35.29	29.59, 41.00		
Doing alright	50.02	43.83, 56.20	40.81	34.94, 46.68		
Just getting by	18.55	13.76, 23.34	18.75	14.09, 23.41		
Difficult	6.65	3.60, 9.71	5.15	2.51, 7.78		
Stress	12.90	11.72, 14.08	13.49	12.37, 14.61	0.06	−0.06, 0.18
Anxiety	6.36	5.47, 7.24	5.00	4.15, 5.85	−0.18	−0.30, −0.06
Depression	10.53	9.30, 11.76	10.94	9.75, 12.13	0.04	−0.08, 0.16
Anger	29.51	28.41, 30.61	22.87	21.81, 23.93	−0.73	−0.86, −0.60

M, mean; CI, confidence interval; ATSI, Aboriginal or Torres Strait Islander; Cert., certificate; Adv., Advanced; d_{av} , Cohen's d for paired data. Estimates derived from pooled values from 20 imputed datasets. Empty cells represent time points when data was not collected. Bold values are significant at $p < 0.05$.

All our primary analytical models (i.e., MLRs) were robust to their underlying assumptions (e.g., influential cases using Cook's $d < 0.20$, heteroskedasticity using residual vs. fitted plot, normality of residuals). Whilst there was some evidence for heteroskedasticity and influential cases in exploratory analyses (see *post hoc* investigations section), the magnitude and direction of effects were not meaningfully altered and were largely attributed to small and unequal cell sizes in these analyses. Given these were exploratory analyses, we report the original results and provide results of sensitivity analyses in **Supplementary Materials**.

Data preparation and MLR analyses were conducted in Stata version 15.1 (45). Variables used in regressions had between 0.4 and 9% missing data that were imputed using multivariate imputation by chained equations (46). Twenty imputed data sets were derived from 50 burn-in iteration of the complete dataset (including 12 auxiliary variables) and pooled using Rubin's (47) rules to derive parameter estimates. Effect sizes were estimated using Cohen's d for between group differences and d_{av} for within-group differences over time (48). Effects were considered significant if pairwise comparisons of marginal means were significant at $p < 0.05$.

RESULTS

Descriptive Statistics

Table 1 presents descriptive statistics for the sample and changes in psychological distress over time. Mean age at T1 was 32 years (range 30–35), and at T2 was 34 years (range 31–37). At T1, most participants had completed post-secondary education, were in paid employment, and in a relationship. At T1 and T2, 25.7 and 23.9% of men reported financial

stress, respectively. There were nuanced changes in psychological distress symptoms. At T1, the proportion of participants with *moderate to very severe* symptoms of stress were 22.60%, anxiety 25.53%, depression 33.65%, and 29.21% reported *very high* anger. At T2, there were small to medium-sized decreases in mean anxiety and anger scores, and a higher probability that men's symptoms were within *normal* levels (anxiety, +7.1%, $p = 0.029$; anger + 50.6%, $p < 0.001$). Mean stress and depression scores and the probability of individuals reporting *normal* symptoms did not change between timepoints. The proportion of men reporting symptoms at each severity level is presented in **Supplementary Figure 1**, Pearson correlations are in **Supplementary Table 2, Supplementary Materials**.

Aim 1: Latent Coping Class Solution

LPA fit statistics are presented in **Table 2**. A three-class model was repeatedly the best fit for coping data from (1) the full sample at T1 ($n = 409$); (2) the subsample at T1 who later participated at T2 ($n = 260$, MI imputed $n = 272$); and (3) the participating sample at T2 ($n = 272$). The three-class model of the T1 subsample had lower AIC and aBIC values and higher entropy (i.e., classification accuracy) than the two-class model. While not significantly better than two classes, visual inspection of coping patterns characterising each class in the three-class model (**Figure 1A**) and a cross-tabulation of class membership with the optimal 3-class model for the full T1 sample showed very high consistency in class characteristics and membership. Similarly, despite non-significant improvement in fit over the two-class solution, the three-class model at T2 also had lower AIC and aBIC values and stronger classification accuracy than the two-class model and similar characteristics to the three-class

TABLE 2 | Model fit indices for LPAs: 2- to 5-class solutions.

Classes	Log likelihood	AIC	BIC	aBIC	Entropy	VLMR	LMR
T1 full sample (n = 409)							
2 classes	−6257.59	12601.19	12773.78	12637.33	0.818	0.006	0.006
3 classes	−6027.15	12170.30	12403.09	12219.05	0.88	0.017	0.018
4 classes	−5901.76	11949.51	12242.52	12010.87	0.86	0.144	0.147
5 classes	−5804.16	11784.31	12137.52	11858.28	0.86	0.447	0.449
T1 subsample (n = 272)							
2 classes	−4006.56	8099.11	8252.22	8115.90	0.84	0.010	0.010
3 classes	−3854.15	7824.30	8030.82	7846.94	0.896	0.237	0.240
4 classes	−3757.95	7661.91	7921.84	7690.40	0.882	0.183	0.185
5 classes	−3688.18	7552.36	7865.70	7586.71	0.904	0.246	0.248
T2 sample* (n = 272)							
2 classes	−3980.19	8046.38	8201.43	8065.09	0.778	0.110	0.112
3 classes	−3834.95	7785.90	7995.04	7811.14	0.849	0.343	0.347
4 classes	Not estimable						
5 classes	Not estimable						

*Same as T1 subsample.

Bold values indicate retained models.

models at T1 (**Figure 1B**). We therefore retained the three-class models for subsequent analyses.

Class Characteristics

The three coping classes exhibited distinct coping patterns across T1 and T2 (**Figure 1**). Class one reported relatively low and balanced use of all strategies, relying most on acceptance, and self-distraction and were labelled *Relaxed Copers* (T1 $n = 111$, 40.9%; T2 $n = 150$, 55.2%). Class two used more active approach-oriented strategies namely planning, active coping, and acceptance so were labelled *Approach Copers* (T1 $n = 128$, 47.1%; T2 $n = 86$, 31.6%). Class three frequently used avoidant strategies (most often self-distraction and self-blame) and moderate to high use of approach-oriented strategies (including planning and acceptance), so were labelled *Dual Copers* (T1 $n = 33$, 12.1%; T2 $n = 36$, 13.2%). Coping subscale scores and contrasts between classes are presented in **Supplementary Tables 3, 4, Supplementary Materials**.

While the distinguishing characteristics of the coping classes (i.e., the overall pattern of approach vs. avoidant strategies) were qualitatively stable across timepoints, there were some minor changes in strategy use from T1 to T2. Based on the 95% confidence intervals around mean strategy use at T1 and T2, Relaxed Copers used more acceptance and humour and less self-blame at T2. Approach Copers used less self-blame and Dual Copers reported less positive reframing and denial.

Aim 2: Associations Between Coping Profiles and Psychological Distress

Table 3 presents adjusted means and standardised differences in symptoms of distress between coping profiles, estimated using MLR models. Dual Copers reported substantially higher

concurrent symptoms of stress, anxiety, depression, and anger than Relaxed Copers ($d = 0.91$ – 1.87) and Approach Copers ($d = 0.85$ – 1.77) both before (T1-T1) and during (T2-T2) the COVID-19 pandemic. Effects were large, even after adjusting for potential confounders. Before and during COVID-19, Relaxed and Approach Coper's symptoms of stress, anxiety and depression were almost entirely within *normal* levels and their anger on average was *high*. Dual Coper's stress and depressive symptoms were *moderate* to *severe* and their anger *very high*.

In longitudinal analyses (T1-T2), Dual Copers at T1 also had higher subsequent symptoms of stress, anxiety, depression, and anger during the pandemic (T2) than men classified as Relaxed or Approach Copers, but these effects became non-significant after adjusting for T1 symptoms and other potential confounders. There were no differences between Relaxed and Approach Copers in concurrent or future psychological distress symptoms. For unadjusted effects see **Supplementary Table 6, Supplementary Materials**.

Aim 3: Associations Between Coping Profiles and Cognitive Appraisals of Pandemic-Related Stressors

Marginal means and standardised differences in coping appraisals between coping profiles are presented in **Table 3**. Dual Copers at T2 appraised the effects of the pandemic as more personally threatening than Relaxed Copers, and more harmful and difficult to overcome, and more strongly needed more information before acting, than both Relaxed and Approach Copers ($d = 0.63$ – 1.00). Both Dual Copers and Approach Copers perceived a stronger need than Relaxed Copers to refrain from their preferred way of coping with the effects of the pandemic. In contrast, Approach Copers at T2 judged the personal effects of the pandemic as more threatening than Relaxed Copers ($d =$

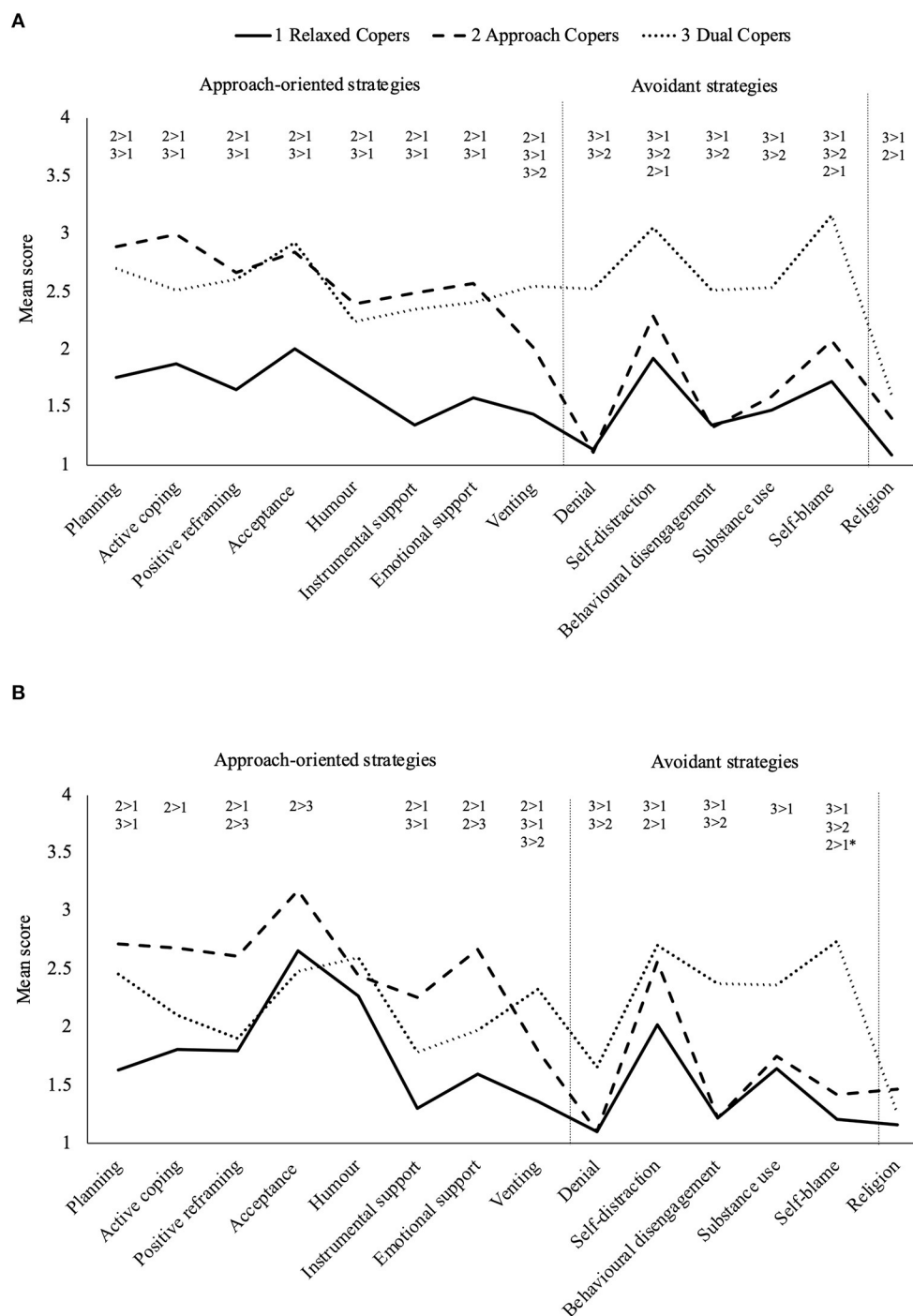


FIGURE 1 | Latent coping classes used by men **(A)** before, then **(B)** during the COVID-19 pandemic. Coping scale range: 1 = *not at all* to 4 = *a lot*. * Near significant contrast with 0.01 95% CI overlap.

0.37), but more strongly perceived these effects as a challenge they could overcome and change directly, compared to Relaxed and Dual Copers ($d = 0.40$ – 1.00). While all coping classes reported high acceptance of some pandemic impacts, Approach Copers

reported higher acceptance than Relaxed and Dual Copers. See **Table 3** for all effects. There were no differences between T1 coping classes in cognitive appraisals during the pandemic (results in **Supplementary Table 5, Supplementary Materials**).

TABLE 3 | Adjusted means and comparisons of psychological distress and coping appraisals by coping classes at T1 and T2 and longitudinally.

Outcome	Relaxed copers		Approach copers		Dual copers		Approach vs. Relaxed		Dual vs. Relaxed		Dual vs. Approach	
	M	95% CI	M	95% CI	M	95% CI	d	95% CI	d	95% CI	d	95% CI
Stress												
T1-T1	10.96	9.24, 12.67	12.56	10.92, 14.21	20.76	17.37, 24.14	0.17	−0.08, 0.43	1.05	0.64, 1.45	0.85	0.46, 1.25
T2-T2	11.88	10.71, 13.06	12.65	11.10, 14.19	22.15	19.59, 24.72	0.10	−0.16, 0.37	1.37	0.98, 1.76	1.27	0.85, 1.69
T1-T2	13.27	11.70, 14.85	13.92	12.46, 15.37	12.53	9.30, 15.76	0.08	−0.18, 0.33	−0.08	−0.47, 0.30	−0.16	−0.54, 0.22
Anxiety												
T1-T1	4.81	3.60, 6.03	5.50	4.39, 6.60	14.93	12.44, 17.41	0.11	−0.15, 0.36	1.50	1.08, 1.93	1.44	1.02, 1.85
T2-T2	4.08	3.23, 4.93	4.35	3.23, 5.47	10.41	8.55, 12.26	0.05	−0.21, 0.32	1.18	0.79, 1.56	1.12	0.70, 1.53
T1-T2	4.84	3.71, 5.97	4.87	3.83, 5.90	6.07	3.73, 8.42	0.00	−0.25, 0.26	0.20	−0.19, 0.59	0.20	−0.19, 0.58
Depression												
T1-T1	10.12	8.38, 11.87	8.75	7.11, 10.39	18.88	15.42, 22.35	−0.15	−0.40, 0.11	0.91	0.51, 1.32	1.05	0.65, 1.45
T2-T2	9.19	8.01, 10.36	10.65	9.08, 12.21	18.96	16.36, 21.56	0.20	−0.07, 0.46	1.31	0.92, 1.70	1.10	0.68, 1.51
T1-T2	10.76	9.19, 12.33	11.23	9.75, 12.70	10.45	7.28, 13.63	0.06	−0.20, 0.31	−0.04	−0.42, 0.35	−0.09	−0.47, 0.29
Anger												
T1-T1	27.49	25.79, 29.20	29.08	27.52, 30.64	38.01	34.68, 41.35	−0.08	−0.08, 0.43	1.13	0.72, 1.54	0.97	0.58, 1.37
T2-T2	21.13	20.11, 22.15	21.59	20.23, 22.95	33.19	30.96, 35.42	−0.19	−0.19, 0.34	1.87	1.45, 2.27	1.77	1.32, 2.22
T1-T2	22.94	21.48, 24.40	22.28	20.95, 23.61	24.97	21.97, 27.96	−0.34	−0.34, 0.17	0.25	−0.14, 0.64	0.34	−0.04, 0.72
Appraisals of pandemic stressors												
Threat	2.39	2.25, 2.52	2.70	2.52, 2.88	2.99	2.71, 3.27	0.37	0.11, 0.64	0.73	0.36, 1.10	0.34	−0.05, 0.73
Harm	2.59	2.44, 2.74	2.81	2.61, 3.00	3.38	3.08, 3.68	0.24	−0.03, 0.50	0.85	0.47, 1.22	0.63	0.23, 1.03
Challenge	3.05	2.92, 3.17	3.36	3.19, 3.53	2.56	2.29, 2.82	0.40	0.13, 0.70	−0.65	−1.01, −0.28	−1.00	−1.40, −0.59
Appraisals of coping options												
Alter	2.47	2.30, 2.65	3.07	2.84, 3.30	2.28	1.92, 2.63	0.54	0.30, 0.81	−0.17	−0.53, 0.19	−0.73	−1.13, −0.33
Accept	4.11	3.98, 4.24	4.42	4.24, 4.59	4.03	3.76, 4.30	0.38	0.12, 0.65	−0.10	−0.46, 0.27	−0.48	−0.87, −0.09
Info	2.87	2.71, 3.02	2.98	2.77, 3.18	3.53	3.21, 3.85	0.12	−0.15, 0.38	0.70	0.33, 1.07	0.58	0.18, 0.97
Refrain	3.03	2.86, 3.20	3.33	3.10, 3.55	3.69	3.35, 4.04	0.28	0.02, 0.55	0.62	0.25, 0.99	0.34	−0.05, 0.73

T1-T1, coping and distress before the pandemic; T2-T2, coping and distress during the pandemic; T1-T2, T2 distress regressed on T1 coping profile. Psychological distress models adjusted for potential confounders. Appraisals regressed on T2 coping profiles. Bold values are significant at $p < 0.05$.

Post hoc Investigations

We examined whether the stability of coping profiles may help explain the negligible prospective association, after adjustment, between T1 coping profiles and T2 psychological distress symptoms and coping appraisals during the pandemic. Forty five percent of men changed coping profiles between T1 and T2 with most adopting a relaxed or approach-oriented profile, shown in **Figure 2**.

Given Dual Coping was associated cross-sectionally with higher psychological distress before and during the pandemic (**Table 3**), we questioned whether men with a stable Dual Coping profile faced a higher mental health risk than men who only adopted the Dual Coping profile during the pandemic. We also queried whether changes in coping profiles were linked to cognitive appraisals of pandemic-related stressors. To answer these questions, we explored whether patterns in profile stability or change was associated with appraisals and psychological distress. To reduce complexity, we combined the Relaxed and Approach Copers classes given their similar relationships with symptoms of distress and member overlap at T1 and T2. This created four longitudinal coping patterns: (1) *Stable Relaxed/Approach Copers* (79.4% of sample) were Relaxed or Approach Copers at T1 and T2; (2) *New Relaxed/Approach Copers* (7.3%) were Dual Copers at T1 but Relaxed or Approach Copers at T2; (3) *Stable Dual Copers* (4.8%) were Dual Copers at T1 and T2; and (4) *New Dual Copers* (8.5%) were Relaxed or Approach Copers at T1 but Dual Copers at T2.

We substituted these four longitudinal coping patterns for the T1 coping profiles in the unadjusted MLR models used to predict coping appraisals, and in the adjusted and unadjusted longitudinal MLR models used to predict symptoms of stress, anxiety, depression, and anger during the pandemic. Results are presented in **Figure 3**, with means and effects for all outcomes reported in **Supplementary Table 7, Supplementary Materials**.

There were no differences between Stable and New Dual Copers in their coping appraisals or adjusted symptoms of distress during the pandemic. Both Stable and New Dual Copers appraised the effects of the pandemic as more personally threatening ($d = 0.50$ – 0.76), harmful ($d = 0.69$ – 1.10), harder to overcome ($d = 0.64$ – 1.14), perceived a greater need to delay

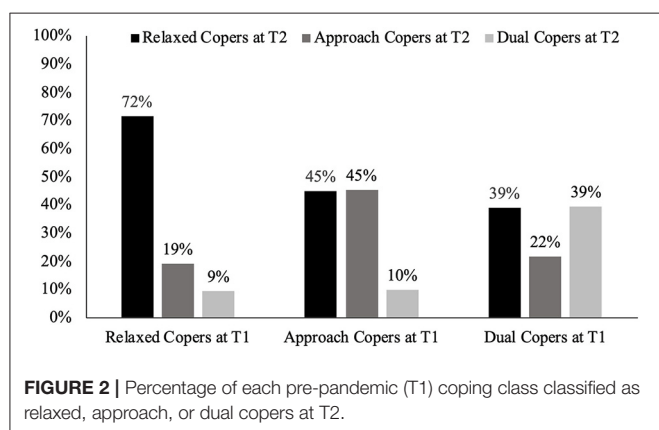
acting until more informed ($d = 0.58$ – 0.76), and experienced substantially higher adjusted stress ($d = 1.23$ – 1.93), anxiety ($d = 1.15$ – 1.40), depression ($d = 1.18$ – 1.75), and anger ($d = 1.86$ – 2.06) than Stable and New Relaxed/Approach Copers, with mostly large effects. Stable (but not New) Dual Copers reported a stronger need than Stable or New Relaxed/Approach Copers to refrain from their preferred ways of coping ($d = 0.68$ – 0.76).

In contrast, New Relaxed/Approach Copers more strongly believed they could change their stressful situation ($d = 0.51$ – 0.84) and experienced lower adjusted stress during the pandemic than other groups ($d = -0.52$ – -1.93). While acceptance was high across groups, Stable Relaxed/Approach Copers were marginally more accepting than Stable Dual Copers ($d = 0.56$, $p = 0.06$). For adjusted and unadjusted effects see **Supplementary Table 8, Supplementary Materials**.

DISCUSSION

We identified three distinct profiles of coping strategies and their associations with symptoms of psychological distress and coping appraisals among Australian men before and during the COVID-19 pandemic. We found that men who frequently tried to avoid or distract from stressors or their implications had elevated symptoms of stress, anxiety, depression, and anger even though these men also regularly used active, approach-oriented coping strategies (i.e., Dual Coping profile) often considered beneficial for adjustment and mental health (2). In comparison, men who infrequently used any coping strategies except acceptance and self-distraction (i.e., Relaxed Coping profile) or who relied on more approach-oriented strategies (e.g., planning, active coping, acceptance) had lower psychological distress. Effect sizes for cross-sectional associations between coping and distress symptoms were moderate to large before and during the pandemic.

Surprisingly, men's pre-pandemic coping profiles failed to predict subsequent symptoms of psychological distress (after adjusting for potential confounders) or coping appraisals during the pandemic. Our findings suggest this may be because almost half the men coped with pandemic stressors differently to their pre-pandemic coping tendencies. Most men who changed profiles relaxed their overall coping efforts, or, less commonly, increased their use of approach-oriented strategies. These coping patterns were associated with lower psychological distress, lower perceived threat and harm, and stronger belief in their ability to overcome the personal impacts of the pandemic. In contrast, men who increased their use of avoidant coping (while still using approach coping strategies i.e., New Dual Copers), perceived the effects of the pandemic as more threatening, harmful, and difficult to overcome. They also perceived fewer options for coping, and experienced similar levels of distress as men who consistently employed high levels of avoidant coping (i.e., Stable Dual Copers), even after adjusting for baseline distress. These findings provide novel evidence of heterogeneity and flexibility in men's coping patterns and a coping profile that may be a covert indicator of mental health risk with important clinical implications.



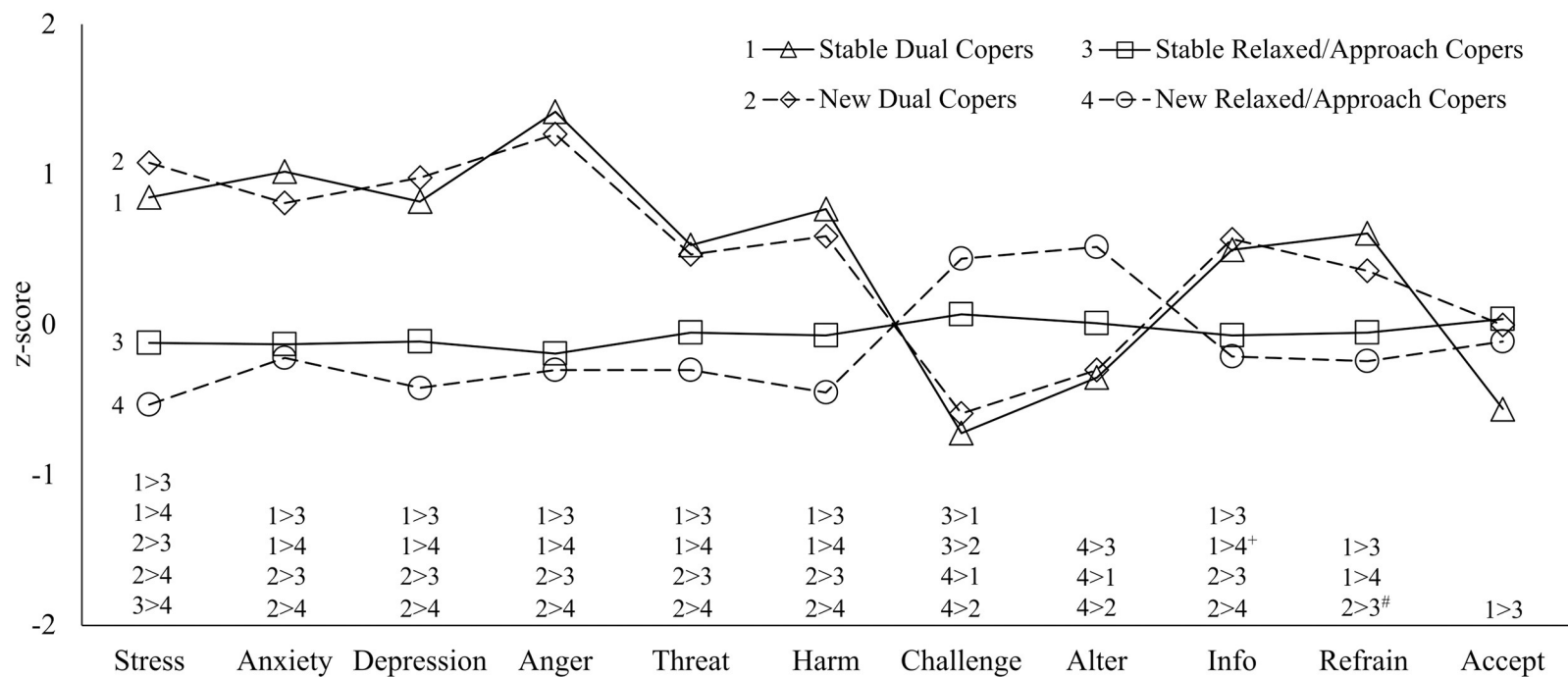


FIGURE 3 | Standardised adjusted mean symptoms of psychological distress and coping appraisals of longitudinal coping patterns. Alter, can alter situation; Delay, need to delay acting until better informed; Refrain, refrain from preferred coping; and Accept, must accept situation. Variables were standardised prior to analyses for figure only. Contrasts are significant at $p < 0.05$, with two exceptions: ⁺ $p = 0.05$. [#] $p = 0.06$.

Our finding of structurally similar coping profiles across time and contexts suggests these coping strategies converge in predictable ways among men aged in their 30's. While the characteristics of the coping profiles are consistent with some (but not all) past studies using combined samples of men and women [e.g., (10, 11)], we provide novel evidence that almost one in two men changed their coping profile over time and stress-contexts. Past research suggests individuals tailor their coping to the demands of a situation but show stable tendencies in their use of specific strategies over time (49, 50). However, this study extends findings from recent studies of women with breast cancer (8) and mixed-gender samples of Norwegian workers and French athletes (11, 51) to show that almost half of our community sample of men changed their total *and* relative use of multiple strategies across contexts. This led to a shift in men's broader coping repertoire that was also linked with distinct coping appraisals. For most of our sample, this flexibility was associated with positive mental health outcomes. Indeed, men who reduced their previous high avoidant coping when dealing with pandemic stressors most strongly believed they could improve their situation and experienced lower symptoms of stress, adjusted for pre-pandemic levels, than other coping groups [consistent with cross-sectional and longitudinal associations between controllability appraisals and stress, anxiety, and depression *during* the pandemic; (19, 26)].

We also found a minority of men *increased* their avoidant coping during the pandemic and reported coping appraisals and increased psychological distress on par with longer-term Stable Dual Copers. These findings align with stress and coping theory (25) and COVID-19 studies on risk and resilience factors (20, 22, 26). While avoidance can be adaptive (52), inflexible or excess use of strategies typically considered maladaptive may interfere with successful use of approach-oriented coping or impair flexible responding (4, 53). For example, denial may delay time-sensitive action (54) while avoidant and disengagement strategies may reduce sensitivity to environmental feedback and hamper flexible responding (4). Moreover, avoidance and distraction are associated with habitual suppression of vulnerable emotions, which is linked with emotional dysregulation and secondary problems in men (12).

These findings indicate that during large scale stressful events, some men experience multiple indicators of vulnerability to mental health problems. Yet their moderate use of active, interactive, and more observable approach-oriented coping strategies may mask their risk. For example, an individual may use humour or seek practical help from others while relying on minimisation or substances to rigidly avoid stress-induced aversive thoughts and emotions. Moreover, some avoidant strategies may be endorsed as traditional masculine-conforming ways of coping with stress and distress (55). For example, qualitative researchers found men's disclosures of depressed feelings (including irritability) may be minimised or dismissed by some mental health professionals who perceive men's alcohol use and efforts to cope independently as expressions of traditional masculinity and lower openness to treatment (56). In this way, the Dual Coping profile—whether stable or newly adopted—may

represent a “masked” or covert risk factor for symptoms of stress, anxiety, depression, and anger among men.

Our finding that men with a (Stable or New) Dual Coping profile most strongly believed they had to delay acting and Stable Dual Copers perceived a stronger need to refrain from their preferred way of coping with the impacts of COVID-19 was partly surprising. In contrast, prior research found a perceived need for more information before acting was associated with higher use of approach-oriented strategies of support seeking and planful problem-solving (37). In our study some men may have had limited access to their social networks during government-mandated lockdowns and felt they had limited control of stressors during the pandemic so turned to avoidance and distraction to manage, reflected in the Dual Coping profile. Moreover, feeling uninformed or receiving misinformation during the initial stages of the pandemic may have fuelled excessive media consumption (57), an approach-oriented strategy that when used inappropriately may constitute a form of ineffective reassurance-seeking previously associated with avoidant coping and anxiety and depressive symptoms during COVID-19 (21). The strong need for refrain and higher anger experienced by Stable Dual Copers has been previously associated with aggression, confrontations with others, and avoidant/escape coping under stress (37, 58–60). While speculative, this suggests long-term Dual Copers may have needed to exercise self-control to refrain from expressing intense (>95th percentile) angry feelings and urges, potentially indicating a risk of verbal or physical aggression.

Strengths and Limitations

A strength of this study was the longitudinal design which enabled us to test associations between pre-pandemic coping and psychological distress during COVID-19 and explore flexibility in coping patterns and links with cognitive appraisals and mental health risk. Consistent with limited pre-pandemic longitudinal analyses of coping profiles [e.g., (11)], our findings indicate that men's coping profiles may not be highly reliable indicators of future risk, however, trajectories of change in coping profiles may be important indicators of men's vulnerability to mental health problems, if our exploratory findings are replicated. Future research should examine risk and protective factors that predict coping trajectories to inform prevention and intervention for mental health difficulties.

While a fraction of our sample did not provide data at both timepoints, the rate of participation at both timepoints is high compared to other longitudinal studies of men (61) and potential bias was minimised via multiple imputation of missing data (62). Consistent with other cohort studies that investigated the impacts of COVID-19 through comparisons with pre-pandemic data [e.g., (63)], within our sample there were variable time lengths between the collection of pre-pandemic and COVID-19 data. This was unavoidable due to the variation in the timing of participant's annual surveys and the emergence of the COVID-19 pandemic.

While the MAPP cohort is representative of similar-aged men in Australia on key demographics, they reported higher

symptoms of stress, anxiety, depression, and anger than population norms (32, 64). This may indicate an elevated risk profile, although evidence suggests prior epidemiological studies of mental health under sampled at-risk men (65). Moreover, evidence suggests online recruitment increases representation of “hard-to-reach” individuals and those with mental health problems (61, 66). Greater sampling of at-risk men may increase our ability to discover relevant relationships between psychological distress and coping. However, our findings may not be generalisable to other subgroups, particularly those differentially impacted by the pandemic [e.g., elderly; (67)]. While we used well-validated self-report measures of psychological distress and coping (29, 68), self-report is vulnerable to bias. Research that triangulates men's self-report with other sources of information such as observant or clinical assessments would strengthen the accuracy and robustness of findings.

Implications

Our findings have implications for clinicians who work with men and those involved in mental health services generally. We present evidence of three distinct coping patterns used by men and elevated psychological distress among those who frequently engage in avoidant coping, which may be masked by their more visible approach-oriented coping behaviours. Indeed, the Dual Coping profile may be a covert risk indicator that contributes to the under recognition and treatment of men's mental health problems (69). This is important because some men are reluctant or unable to disclose their distress, often delay seeking help until in a crisis (70, 71), and may have their expressions and management of stress and distress overlooked or misunderstood by clinicians influenced by gender biases (56).

Previous research examining men's help-seeking recommends clinicians focus on action-oriented psychological interventions due to men's preference for active, problem-focused strategies and skills (72). However, our findings suggest a simultaneous overreliance on avoidant coping strategies (e.g., denial, distraction, disengagement) may leave some men vulnerable to developing or experiencing ongoing symptoms of distress. This includes feelings and urges relating to anger, which if enacted may result in verbal and/or physical aggression (73), and/or fuel chronic hostility and criticism of self and others that can predispose and perpetuate emotional and relational problems (74, 75).

We also identified cognitive themes that may help identify at-risk men for further assessment and tailored psychosocial support. Consistent with other COVID-19 studies (19), appraisals of pandemic-related stressors as personally threatening, loss-inducing, and uncontrollable were associated with more avoidant coping through the Dual Coping profile. We further found that a perceived need for restraint or delay in responding (until better informed) may be additional indicators of risk, consistent with growing evidence that at-risk men

often delay help-seeking (70). These appraisals warrant further investigation given their previous links with interpersonal confrontations, the latter a potential sign of difficulties with aggression, and the exploratory nature of our analyses.

Conclusions

This study examined links between men's patterns of coping with stress, coping appraisals, and psychological distress over time and contexts, including the first wave of the COVID-19 pandemic in Australia. Men who engaged in high levels of avoidant coping and moderate-high approach-oriented strategies experienced elevated symptoms of stress, anxiety, depression, and anger and cognitive appraisal themes of fear, loss, uncontrollability, delay, and restraint. These findings, if replicated, suggest indicators of men's vulnerability to psychological distress; including risk potentially masked by active and interactive approach-oriented coping typically more visible than some avoidant coping strategies. Most importantly, these findings contribute to ongoing work to identify cognitive and behavioural targets for screening and treatment of men's mental health difficulties.

DATA AVAILABILITY STATEMENT

The data analysed in this study is subject to the following licences/restrictions: Access to MAPP data is governed by the study investigators and can be initiated via contact with Dr. Jacqui Macdonald (corresponding author). Data sharing must be consistent with ethical approvals for participant consent, confidentiality and data management. MAPP ethics approvals do not include participant consent for public availability of our data sets. However, we support requests for reuse of data for validation, verification or confirmation of previous research, subject to available resources at the time of the request to undertake sufficient deidentification of data for sharing. Requests to access these datasets should be directed to Dr. Jacqui Macdonald, jacqui.macdonald@deakin.edu.au.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Deakin University, Faculty of Health, Human Research Ethics Advisory Group. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JL, JM, and GY: study conceptualisation and design. JM and CO: longitudinal MAPP study conceptualization, design, and cohort experts. JL, JM, LE, and CG: data collection and preparation. JL overseen by JM and GY: study statistical analyses and interpretation of results. JL overseen by JM: drafting of original

manuscript. All authors critically reviewed and approved the final manuscript.

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Impacts of the COVID-19 Pandemic on Mental Health and Potential Solutions in Different Members in an Ordinary Family Unit

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INTRODUCTION

Coronavirus disease 2019 (COVID-19) was first reported in Wuhan City, China, in December 2019 (1). Owing to the exceptionally rapid transmission and robust infectiousness of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), and its high mortality and morbidity, the COVID-19 pandemic has swiftly led to a global public health crisis. As of November 3, 2021, there were ~248.007 million confirmed cases and over 5.0 million deaths in more than 200 countries worldwide (2).

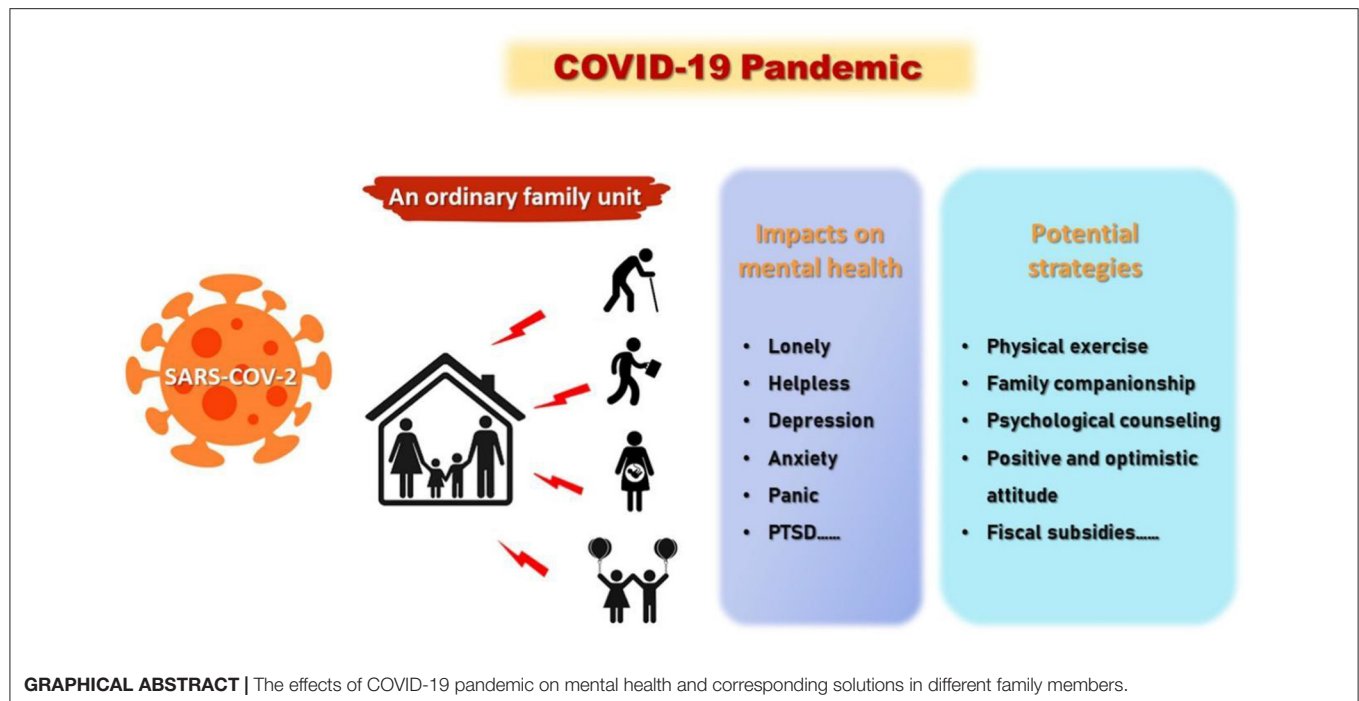
COVID-19 has not only significantly affected the physical health of tens of millions of people worldwide but also affected individuals' mental health. Fear of the unknown virus, massive and long-term quarantine measures and economic losses, lack of basic supplies, cancelation of public events, and closing mass transit systems resulting from isolation have exacerbated stress and anxiety among the public, thus increasing individuals' risk of developing psychological disorders (3–6). According to the World Health Organization report on August 27, 2020, COVID-19 has affected the mental health of millions of people worldwide (7).

Since the outbreak of COVID-19, the mental health of medical workers and patients has been under intense scrutiny, and they have received a variety of psychological counseling and other treatments (8, 9). However, the mental health of the general population has received little attention concerning in comparison to healthcare workers and patients. To illustrate the public's psychological responses, we reviewed the potential causes and consequences of the adverse impacts of COVID-19 on the mental health of older adults, working adults, children and adolescents, and pregnant women by simulating an ordinary family unit, and put forward a series of targeted psychological crisis intervention measures. These addressed mental health issues would contribute to taking appropriate psychological interventions by the governments based on the characteristics of age-dependent groups. In fact, people of different ages experienced distinct psychological distress and emotional responses to the ongoing COVID-19 pandemic because they play different roles in a family.

OLDER ADULTS

According to statistics from the Chinese Center for Disease Control and Prevention (China CDC), in the confirmed COVID-19 cases, the risk of prevalence and death rates increase with advancing age, i.e., the prevalence rate of people over 50-years-old in China was 53.6%. More seriously, the death rate for people over 50-years-old was 93.7% among 1,023 deaths (10).

Older adults are relatively psychologically fragile and vulnerable to the influence of the external environment, while the high morbidity rate and high mortality rate of the pandemic among the



elderly further increase their psychological stress (11). First, over the past century, the sharp growth of aging populations has resulted in more aged people living alone. Aged people are more prone to have lonely and helpless feelings owing to a lack of emotional support from their children. Such feelings could be exacerbated and even result in mental disorders during the COVID-19 pandemic (11). Second, aging has been a major risk factor for chronic diseases, including cardiovascular diseases, diabetes, cancer, and neurodegenerative diseases (12, 13). These common morbidities render aged people more susceptible to the SARS-CoV-2 virus. However, owing to the isolation at home during the pandemic and the inability to go to the hospital for treatment, many older adults with chronic age-related diseases are more worried about their physical health, which further aggravates the prevalence of mental illness (12, 14). Third, as mandatory quarantine measures are taken, older adults may show a series of psychological disorders when changing their daily routines, such as reducing outdoor activities and social interactions during the COVID-19 pandemic (3, 11). Finally, containing the spread of the virus has entailed a dramatic shift from face-to-face to remote consulting for mental health professionals (11). Unfortunately, few older people are proficient in using internet services, which poses great challenges to their ability to access mental health services.

To lessen the potential impacts of psychological health and mental stress associated with the ongoing COVID-19 pandemic on aged people, several measures should be considered by family members and local governments. First, older adults could live together with their families to facilitate timely emotional communication and reduce loneliness. Alternatively, elders can also stay connected to friends and family members via traditional means (wired phones and letters) or advanced means (email,

WeChat, online voice, and video chat) of communication (11, 15). Second, through community-based integrated care approaches, regular medical care and protective measures for those with chronic age-related diseases should be provided by community-based resources such as social services. Furthermore, timely and effective communication and targeted psychological interventions among multidisciplinary mental health teams about COVID-19 should be provided for elderly patients with persistent psychological symptoms. Third, occupational health experts can encourage the elderly to exercise to release their worries and anxiety and improve their immunity and cognitive performance (16). Elders should also be encouraged to obtain information from multiple regular media resources, such as television, newspapers, and radio, to relieve their anxieties and worries (17).

WORKING ADULTS

In most ordinary families, the mental health of working adults can be easily overlooked during the pandemic. However, when facing unprecedented uncertainties, they may suffer great psychological pressure. First, the COVID-19 outbreak triggered a global economic recession, causing many unemployed or underemployed (18–20). Second, due to the stay-at-home policy during the pandemic in many countries, it is estimated that approximately one-half of the companies had more than 80% of their employees working from home during the early stages of the COVID-19 pandemic (20). Against this backdrop, both the limitations of the workspace and lack of positive social interaction are likely to have side effects that further aggravate people's stress (3). In China, an increasing number of adults

are facing severe financial pressures, and some adults even cannot pay for basic requirements, including housing, food, and healthcare (21, 22). Such direct threats to the livelihood of working adults may harm their mental health more so than the ongoing disease itself. Third, a surge in domestic violence has been reported amidst the COVID-19 pandemic. Especially for females, employment and income source act as a buffer against violence; unemployment takes off this buffer and makes them vulnerable to violence at the hands of spouses (23). According to statistics from the National Commission for Women, India, there has been a 100 % increase in complaints related to violence against women after the nationwide lockdown was imposed in just 1 month (24). Finally, a return-to-work policy in many countries has been employed to compensate for the economic loss caused by the outbreak. However, the proportion of confirmed infections in many working adults has increased remarkably (25); therefore, for working adults, returning to work may increase their risk of infection, which will exacerbate their psychological burdens. Economic losses, family burdens, and domestic violence may lead to stress, anxiety, and other mental illnesses.

Given that the threats of psychological health deterioration to working adults cannot be neglected when we are fighting against the COVID-19 pandemic, several measures need to be implemented. First, people's financial losses should be identified during the isolation period by relevant government departments, and relief supplies and financial subsidies must be provided on a timely basis. Furthermore, the government should create more job positions for those who are unemployed or underemployed as soon as possible. In addition, for those who have changed their working style, it is necessary to help them get used to the new way of working and improve their ability and quality in time. Working adults should return to work in an orderly and periodic manner with governmental permission, as long as the COVID-19 pandemic is effectively controlled. Third, community social workers can play an active role in helping people cope with family issues (17). Besides, community psychological interventions and support might have some effects in reducing depressive and anxiety symptoms in adults during these stressful events (17). Notably, social support was the most important protective factor against psychological sequelae of the COVID-19 pandemic in working adults. It has been proposed that high-quality social support from family members and friends may alleviate anxiety and worry and enhance psychological and social relationships (26–29).

CHILDREN AND ADOLESCENTS

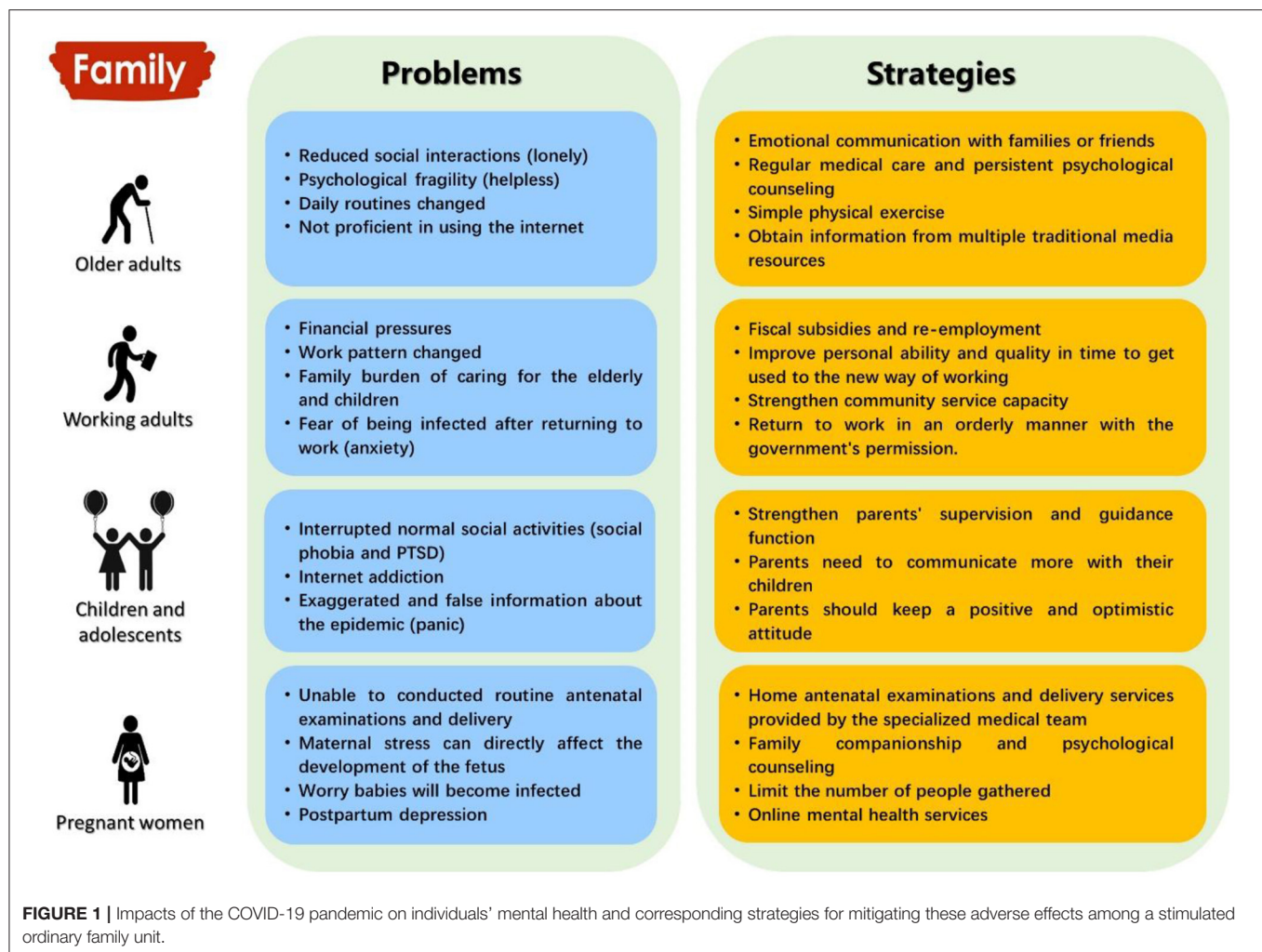
Among children and adolescents, the confirmed COVID-19 cases and death cases are less prevalent (2.1% of 44,672 confirmed cases) and less lethal (0.1% of 1,023 deaths) in China (10). Similar findings have been reported in other countries with more severe outbreaks (30). However, although the prevalence of COVID-19 among children is low, the extensive impact of the

pandemic on children's mental health cannot be ignored. First, the periods of children and adolescents face a high degree of vulnerability to adverse environmental conditions (31), and the relative immaturity of the brain may make it particularly sensitive to stress-induced dysfunctions, with both immediate and lasting consequences on mental health (32). Second, to prevent the further spread of COVID-19, many countries have ordered school closures as an emergency solution (3, 4). Prolonged school closure can disrupt the normal social activities of young people with their classmates and teachers, which can have serious negative effects on their mental health, such as causing social phobia, anxiety, restlessness, and autism spectrum disorder (3, 33). Third, with many classes switched from offline to online, young people are spending significantly more time online, increasing their dependency on the internet (34). Additionally, internet engagement has increased among students because face-to-face interaction and activities are restricted. Students are more likely to be engaging in other online activities such as social media use and online gaming, which may be associated with internet addiction (35, 36). All these changes also exacerbate the conflicts between parents and children, which are associated with an increased risk of stress-related mental illness (37). In addition, children's ability to access too much information about the pandemic (infodemic) over the internet could easily cause panic (15).

Thus, close attention to children and adolescents is required to address these emergency issues effectively and avoid any long-term negative consequences for the rest of their lives. First, some low-risk areas began a phased resumption of classes with the outbreak under the initial control, which allowed children to play with their friends. Second, parents' supervision and guidance should be strengthened to prevent children from excessive internet use. Significantly, parents need to communicate more with their children to avoid further intensification of conflicts. Finally, to reduce children's excessive access to pandemic information by controlling their online time, parents should also keep a positive and optimistic attitude to avoid negative emotions affecting their children. Additionally, it is important to consider post-pandemic surveillance of mental disorders among children and adolescents (38). Furthermore, children and adolescents should stay physically active and engage in regular exercise to avoid the risk of physical and mental ill-health (38–42).

PREGNANT WOMEN

Relevant studies indicated that pregnant women may be more susceptible to COVID-19 (43, 44). As special members of the families, therefore, we should also pay close attention to the psychological status of pregnant women during the pandemic. First, gestation is a time of significant psychological and physiological vulnerabilities; the higher psychosocial stress during this period can increase susceptibility to several mental disorders, including schizophrenia, mood disorders, high levels of anxiety, and autism (45). Second, during an



outbreak, owing to the high potential risk of exposure to SARS-COV-2 in the hospital environment and the strict quarantine policy, many pregnant women were unable to conduct routine antenatal examinations or delivery, which may make them feel highly stressed and anxious (45, 46). Furthermore, some pregnant women worry that their babies will be infected after they are born during a pandemic. These fears have further deepened the postpartum anxiety of pregnant women (43, 44). Most noteworthy, the higher maternal psychosocial stress during gestation can directly affect the development of the fetus (47). A series of studies worldwide have reported a significant rise in the proportion of preterm (43) and stillbirth (48, 49) in pregnant women since the COVID-19 pandemic started. In addition, COVID-19 can also affect the health and well-being of mothers and their newborns by altering immune responses at the maternal-fetal interface (43).

In sum, owing to women being fragile physical condition during pregnancy, isolation at home for a long time, and

worrying about one's baby, an increase in postpartum depression and other psychological problems is likely (46). Therefore, effective measures should be adopted to relieve the stress and anxiety of pregnant women. First, when the pandemic hit, some face-to-face consultations were substituted with online remote appointments to protect pregnant women from the coronavirus. However, medical workers cannot directly measure some critical physiological indicators of pregnant women, such as blood pressure, babies' heartbeat, and development status. Therefore, home antenatal examinations and delivery services should be provided by a specialized medical team to reduce visits to high-risk areas such as hospitals (46, 50). Second, during pregnancy, family companionship and psychological counseling are necessary, which can effectively reduce the psychological pressure on pregnant women. Moreover, to protect newborns, a mother should limit the number of people they have contact with (44). Finally, other online strategies, such as online mental health services or telemedicine, can help alleviate the psychological

problems of pregnant women by communicating with others remotely (51–53).

CONCLUSION

Among the general public, the sudden outbreak and prolonged duration of the COVID-19 pandemic have led to a series of adverse mental health problems. Given that there was limited information regarding mental health issues related to infectious diseases in past epidemics and pandemics, the general population received little attention concerning the diverse psychological impacts and mental health disorders. We analyzed the potential causes and consequences of the pandemic on mental health in different populations in an ordinary family unit with older adults, working adults, children and adolescents, and pregnant women, and then addressed several specific solutions to lessen the mental stress caused by the COVID-19 pandemic for each group (Figure 1). This information would contribute to establishing universal protocols and guidelines for the future, and inform appropriate and feasible guidance for successfully preventing the ongoing pandemic-related mental health problems to

minimize the adverse impacts of the COVID-19 pandemic on mental health.

AUTHOR CONTRIBUTIONS

LW and GN: investigation and writing—original draft preparation. LZ: investigation. DL: writing—review and editing. DL and YW: conceptualization, supervision, and funding acquisition. All authors contributed to the article and approved the submitted version.

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Social Media Use and Its Associations With Mental Health 9 Months After the COVID-19 Outbreak: A Cross-National Study

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Background: The covid-19 pandemic has impacted the health and well-being of millions across the globe. Strict social distancing policies and periodic lockdowns has led to an increased reliance on alternative online means of communication, including social media.

Objectives: to examine (i) social media use and mental health in the general population 9 months after the COVID-19 pandemic outbreak and (ii) mental health in relation to motives for and extent of social media use, while adjusting for sociodemographic variables.

Methods: A cross-national online survey was conducted in Norway, UK, USA and Australia. Participants ($n = 3,474$) reported extent of and motives for social media use and completed the 12-item General Health Questionnaire. The data were analyzed by chi-square tests, one-way analyses of variance, and multiple linear regression analysis.

Results: Poorer mental health was associated with using social media to decrease loneliness and for entertainment motives, while better mental health was associated with using social media for personal contact and maintaining relationships. Overall increased daily time on social media was associated with poorer mental health. The social media use variables were responsible for a substantial proportion of the outcome variance explained. These findings were consistent across the four countries, with only minor variations.

Conclusions: Motives for using, and time spent using, social media were associated with the participants' mental health. Guidance and recommendations for social media usage to the general public for prevention and intervention for behavioral health may be beneficial.

Keywords: coronavirus, cross-national study, pandemic, psychological distress, mental health, social distancing, social media, motives

INTRODUCTION

The coronavirus pandemic has affected the lives of millions of people in various ways (1). Due to the high infection- and mortality rates caused by the virus, a number of strict measures have continued to be imposed by bodies of government across the world. A key element of these measures for individuals has been to reduce social contacts outside of the household or living situation. As a consequence, social distancing has become the new norm (2). The severity of the rules of social distancing has varied across regions and countries over time, as infection-rates have gone up or down. In general, however, people have been asked to reduce the number of contacts with individuals who are not a part of their household (3). Many schools, universities and workplaces have been closed or offered digital solutions only for students or employees (4). Also, many shops, restaurants and pubs have been closed for in-person gatherings, as well as many cultural- and social arenas, including cinemas and theaters, indoor sports activities and religious gatherings. Some countries have restricted travel or implemented additional screening requirements.

A number of studies have raised concerns about the coronavirus policies on people's lives and mental health, including its practical, social and financial aspects (5–7). For example, increased levels of anxiety, depression and loneliness has been reported (8). Other studies have shown a significant increase in emotional stress, also over time (6, 8–10). An important implication of the social distancing measures is the increased use of alternative means of communication, including social media (11). Social media is here understood as “applications that allow users to engage in virtual interactions, with broader or narrower audiences” (12).

Pre-coronavirus studies into the connections between social media use and mental health have revealed an ambiguous relationship (11, 13). Social media may be a source of entertainment, connection and information, while it may also fuel anxiety and stress (14). For example, daily use of social media has been associated with poorer mental health in young people (14, 15). The same two-sidedness is found in studies on social media use and mental health in the context of the current pandemic (16, 17). Although social media clearly has played an important role in connecting people during these times of extraordinary circumstances, the increased reliance on online means of communication and contact has also raised important concerns. For example, the overabundance of information on the coronavirus—some accurate, some not—prompted the warnings against the “infodemic” and anxiety caused by social media exposure (11, 18, 19). Also, as communication via social media does not fully compensate for face-to-face contact, prolonged periods of social distancing give rise to concerns about increased levels of loneliness (20).

Another important issue relates to association between motives for social media use and mental health. The literature on motives for social media use point at the many benefits that social media provide for its users (21–23). Interestingly, some of these studies point at the level of engagement with other (social media) users, as of particular importance in relation to mental

health outcomes (24, 25). Active use of social media, where the person is in direct interaction with others, has been found to contribute to less loneliness and fewer mental health symptoms (22, 24). Passive use, on the other hand, such as scrolling through others' posts, has been associated with increased depressive symptoms, rumination and generally poorer mental health outcomes (24, 26).

Despite the growing literature on the coronavirus and its associations to mental health, studies on motives for social media use and its relationship to mental health are scarce. Specifically, studies need to expand from crude time-use measures of social media use, and need also to investigate whether associations with mental health are valid across countries and regions. Further, given the differences in social media use between sociodemographic groups, associations between social media use and mental health need to be corroborated by adjustments for sociodemographic background. All these requirements are addressed in the current cross-national study. The aim of this cross-national study was to examine (i) social media use and mental health in the general population 9 months after the COVID-19 pandemic outbreak, and (ii) examine mental health in relation to motives for and extent of social media use, while adjusting for sociodemographic variables.

METHODS

Design and Procedures

The study is a cross-sectional survey conducted in Norway, USA, UK, and Australia. The online survey was distributed through social media platforms (i.e., Facebook, Twitter) in each of the involved countries between 24 October and 29 November 2020. A landing site for the survey was established at the researchers' universities; OsloMet - Oslo Metropolitan University, Norway; University of Michigan, USA; Northumbria University, UK; and the University of Queensland, Australia. The initiator of the project was AØG from OsloMet. Due to ethical considerations and permissions in each of the countries, each country had their own project lead. The survey was developed by the researchers in two languages; Norwegian and English, and was based on a previous survey conducted by the research group in the early phase (April 2020) of the pandemic outbreak (8, 27, 28). Language and cultural differences were considered during the survey development process.

Inclusion and Exclusion

To be included in the study, participants had to be 18 years or older, understand Norwegian or English and live in Norway, USA, UK or Australia with access to the internet and electronic device. There were no additional exclusion criteria.

Measures

Sociodemographic Characteristics

Sociodemographic variables included age group (18–29, 30–39, 40–49, 50–59, 60–69, 70 years and above), gender identity (male, female, other, prefer not to respond), highest completed education level (high school or associated/technical degree or lower, bachelor's degree, master's/doctoral degree), cohabitation

(living with a spouse or partner, or not), and employment status (having full-time or part-time employment, or not).

Social Media Use

The participants were asked to indicate the amount of time they had spent on social media on a typical day during the last month. In line with the work of Ellison and co-workers, (29) response options were <10 min, 10–30 min, 31–60 min, 1–2 h, 2–3 h, and more than 3 h.

The participants were also asked about seven possible motives for using social media. These questions were adapted to a more general form based on Teppers et al. (30), whose study was concerned with one particular social media. The items were phrased: “Nowadays I use social media...” with the following endings: “to feel involved with what’s going on with other people” (personal contact motive), “because it makes me feel less lonely” (decrease loneliness motive), “so I don’t get bored” (entertainment motive), “to keep in contact with my friends” (maintaining relationships motive), “because I dare say more” (social skills compensation motive), “to be a member of something” (social inclusion motive), and “to make new friends” (meeting people motive). Response options for these items were never (1), seldom (2), sometimes (3), often (4) and very often (5).

Mental Health

General Health Questionnaire 12 (GHQ-12) is widely used as a self-report measure of mental health (31, 32). A large number of studies in the general adult, clinical, work and student population

have provided support for its validity across samples and contexts (32–36). Six items of the GHQ-12 are phrased positively (e.g., “able to enjoy day-to-day activities”), while six items are phrased as a negative experience (e.g., “felt constantly under strain”). For each item, the person indicates the degree to which the item content has been experienced during the two preceding weeks, using four response categories (“less than usual,” “as usual,” “more than usual” or “much more than usual”). Items are scored between 0 and 3, and positively formulated items are recoded prior to analysis. As a result, the GHQ-12 scale score range is 0–36, with higher scores indicating poorer mental health (more psychological distress). Cronbach’s α for the GHQ-12 was 0.91.

Statistical Analysis

Analyses were performed for the total sample and for each of the four countries. Descriptive analyses were performed for all included variables. Differences in GHQ scores between countries were investigated with independent *t*-tests and one-way analysis of variance (ANOVA). Multiple linear regression analysis was used to assess direct associations between each of social media use variables and mental health, while adjusting for all included variables. Variables were entered in two steps, representing sociodemographic variables: age group, gender, education level, cohabitation status and employment; and social media use: scores on personal contact motive, decrease loneliness motive, entertainment motive, maintaining relationships motive, social skills compensation motive, social inclusion motive, meeting

TABLE 1 | GHQ scores by participant characteristics in the total sample and in each country.

Characteristics	Total sample M (SD)	USA M (SD)	UK M (SD)	Norway M (SD)	Australia M (SD)
Age group					
18–29 years	18.9 (6.8)***	18.5 (6.8)***	20.7 (6.9)***	18.4 (6.2)***	17.7 (7.3)
30–39 years	17.4 (6.5)	17.5 (6.4)	17.9 (6.5)	16.8 (7.0)	15.1 (5.6)
40–49 years	16.5 (6.7)	16.6 (6.2)	17.8 (7.2)	15.1 (7.2)	14.2 (6.5)
50–59 years	15.4 (6.7)	14.9 (6.4)	17.9 (6.7)	13.7 (6.6)	15.0 (7.1)
60–69 years	14.5 (6.3)	14.4 (5.8)	16.8 (7.1)	13.1 (7.0)	15.1 (7.0)
70 years +	12.9 (5.8)	13.2 (5.5)	15.0 (7.0)	10.9 (5.6)	13.2 (6.8)
Gender identity					
Male	14.8 (7.1)***	14.7 (6.9)***	17.5 (7.6)	13.0 (7.2)**	14.3 (6.0)
Female	16.9 (6.6)	16.9 (6.2)	18.6 (6.8)	15.4 (6.9)	15.1 (7.0)
Education level					
High school/tech. degree or lower	16.8 (7.4)***	16.0 (7.0)**	18.8 (7.6)	17.0 (7.7)***	16.5 (7.9)
Bachelor’s degree	16.8 (6.9)	17.1 (6.8)	18.7 (6.7)	14.6 (7.1)	14.9 (6.7)
Master’s/doctoral degree	15.7 (6.2)	16.0 (6.6)	17.4 (6.6)	13.8 (6.2)	14.6 (6.3)
Cohabitation					
Yes	15.8 (6.5)***	16.1 (6.3)**	17.2 (6.6)***	13.9 (6.6)***	13.5 (5.6)**
No	17.3 (7.2)	16.8 (7.0)	20.0 (7.2)	16.4 (7.3)	17.5 (7.8)
Employment					
Full-time or part-time	16.5 (6.6)	16.7 (6.3)**	18.0 (6.8)	14.4 (6.5)**	15.3 (6.7)
No employment	16.3 (7.3)	15.6 (6.9)	19.2 (7.4)	16.1 (8.1)	15.3 (7.1)

Statistical tests are one-way ANOVA *F*-test (age groups and education level) and independent *t*-tests (all other variables). *p*-values refer to differences within the total sample and within each of the subsamples. Cohabitation refers to “living with spouse or partner.” Higher GHQ scores indicate poorer mental health. ***p* < 0.01, ****p* < 0.001.

people motive; and time spent on social media daily during the last month. Standardized beta weights (β) were reported as effect size, and according to Cohen (37), effect sizes about 0.10 were interpreted as small, effect sizes about 0.30 as moderate, and effect sizes about 0.50 as large. The outcome variance proportions explained by the models were reported. Statistical significance was set at $p < 0.05$. Missing values were handled by case-wise deletion.

Ethics

The data collected in this study were anonymous. The researchers adhered to all relevant regulations in their respective countries concerning ethics and data protection. The study was approved by OsloMet (20/03676) and the regional committees for medical and health research ethics (REK; ref. 132066) in Norway, reviewed by the University of Michigan Institutional Review Board for Health Sciences and Behavioral Sciences (IRB HSBS) and designated as exempt (HUM00180296) in USA, by Northumbria University Health Research Ethics (HSR1920-080) in UK, and (HSR1920-080 2020000956) in Australia.

RESULTS

Participants

Participants included 3,474 individuals from Norway ($n = 547$, 15.7%), USA ($n = 2130$, 61.3%), UK ($n = 640$, 18.4%) and Australia ($n = 157$, 4.5%). In the total sample, there was a spread across age groups, with a lower proportion of the oldest participants (above 70 years). There were less men than women (22.2% men vs. 73.3% women). Seventy-one percent had a

bachelor's degree or higher levels of education. Full-time or part-time employment was held among 66.3%, while 58.7% lived with a spouse or partner.

Mental Health in Sample Subgroups

Table 1 displays the levels of mental health according to sample subgroups in the total sample and for each of the four countries. In the total sample, mental health was better in the older age groups, and men reported better mental health than women. Participants with higher levels of education reported better mental health compared to those with lower education levels, while those living with spouse or partner reported better mental health than their counterparts. Mental health was not significantly different between participants with and without employment.

The overall pattern of better mental health in the older age groups was consistent across all countries, with significant differences between older and younger age groups found for USA, UK and Norway. Among participants in the USA, mental health was significantly better among those not employed, compared to their employed counterparts, whilst in Norway, better mental health was found among those who were employed.

Social Media Use and Mental Health

The mean scores for each of the seven purposes or motives for social media use are reported in **Table 2**. In the total sample, the highest mean score was shown for the motive for maintaining relationships, while the motive for meeting people was least endorsed. Sixty-two percent of the sample reported using social media for at least 1 h daily, while 21% reported using social media for more than 3 h daily.

TABLE 2 | Social media use motives and time spent in the total sample and in the four countries.

Motives	Total sample M (SD)	USA M (SD)	UK M (SD)	Norway M (SD)	Australia M (SD)	<i>p</i>
Personal contact	3.5 (1.0)	3.6 (1.1)	3.4 (1.1)	3.3 (1.0)	3.4 (1.0)	<0.001
Decrease loneliness	2.7 (1.3)	2.7 (1.3)	2.6 (1.2)	2.5 (1.2)	2.4 (1.2)	<0.001
Entertainment	3.5 (1.1)	3.6 (1.1)	3.5 (1.2)	3.5 (1.2)	3.1 (1.2)	<0.001
Maintaining relationships	3.7 (1.0)	3.7 (1.0)	3.8 (1.0)	3.6 (1.0)	3.6 (1.0)	<0.05
Social skills compensation	2.0 (1.1)	2.1 (1.2)	1.8 (1.0)	1.5 (0.8)	1.8 (1.0)	<0.001
Social inclusion	2.3 (1.2)	2.3 (1.2)	2.2 (1.2)	2.5 (1.2)	2.4 (1.2)	<0.01
Meeting people	1.6 (0.8)	1.6 (0.9)	1.6 (0.9)	1.5 (0.8)	1.5 (0.8)	<0.01
Daily time on social media	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<0.001
<10 min	77 (2.2)	24 (1.3)	14 (2.7)	36 (6.6)	3 (2.3)	
10–30 min	272 (7.8)	145 (8.1)	47 (9.1)	69 (12.6)	11 (8.5)	
½–1 h	492 (14.2)	267 (14.9)	90 (17.5)	108 (19.7)	27 (20.9)	
1–2 h	859 (24.7)	500 (27.9)	131 (25.4)	189 (34.6)	39 (30.2)	
2–3 h	567 (16.3)	429 (23.9)	107 (20.8)	2 (0.4)	29 (22.5)	
3 h or more	718 (20.7)	1,794 (23.9)	515 (24.5)	547 (26.1)	129 (15.5)	
Mental health	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	<i>p</i>
GHQ score	16.4 (6.8)	16.4 (6.6)	18.3 (7.0)	14.9 (7.0)	15.2 (6.9)	<0.001

Response options for the motive items were never (1), seldom (2), sometimes (3), often (4) and very often (5). In total, 2,980 (85.9%) of the participants responded to the question about daily time spent on social media. *p*-values, indicating the probability of between-country differences in the population, refer to the ANOVA *F*-test (motives and mental health) and the Chi-square test (daily time on social media).

TABLE 3 | Adjusted associations with GHQ scores in the total sample and in the four countries.

Independent variables	Total sample	USA	UK	Norway	Australia
Sociodemographic variables	β	β	β	β	β
Higher age	−0.17***	−0.17***	−0.05	−0.22***	−0.08
Female gender	0.06***	0.06*	0.07	0.05	−0.03
Higher education level	−0.04	−0.03	−0.03	−0.02	0.00
Living with spouse/partner	−0.04*	0.00	−0.14**	−0.03	−0.22*
Having employment	−0.05**	−0.02	−0.07	−0.16***	−0.04
R² change	9.9%***	9.2%***	7.6%***	18.4%***	10.6%*
Social media use					
Personal contact motive	−0.07**	−0.07*	−0.08	−0.07	−0.05
Decrease loneliness motive	0.29***	0.34***	0.11*	0.27***	0.18
Entertainment motive	0.13***	0.11***	0.21***	0.17**	0.20
Maintaining relationships motive	−0.10***	−0.09**	−0.16**	−0.14**	−0.04
Social skills compensation motive	0.03	−0.01	0.08	0.15**	0.03
Social inclusion motive	0.03	0.05	−0.08	0.09	0.15
Meeting people motive	−0.03	−0.05	−0.00	−0.07	−0.11
Time spent on social media daily	0.07***	0.09***	0.07	0.01	0.15
R² change	12.0%***	14.3%***	7.8%***	14.9%***	17.6%**
Explained variance	21.8%***	23.5%***	15.3%***	33.3%***	28.2%***

Standardized beta values (β) indicate strength of associations adjusted for all included variables.

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

There were statistically significant differences between the four countries regarding the participants' endorsement of motives for social media use. Across countries, though, there were high endorsements for the personal contact, entertainment and maintaining relationships motives (at similar levels), while the lowest level of endorsement was found for the meeting people motive. Mental health was also significantly different between the four countries. Participants in the UK had poorer mental health compared to all other countries, while participants in the USA also had poorer mental health compared to participants in Norway. The levels were not significantly different between Norway and Australia.

Associations Between Mental Health and Social Media Use

Adjusted associations between social media use and mental health are displayed in **Table 3**. In the multiple regression analysis for the total sample, better mental health was associated with higher endorsement of the personal contact motive ($\beta = -0.07$, $p < 0.001$) and the maintaining relationships motive ($\beta = -0.10$, $p < 0.001$). Poorer mental health was associated with higher endorsement of the decrease loneliness motive ($\beta = 0.29$, $p < 0.001$) and the entertainment motive ($\beta = 0.13$, $p < 0.001$). In addition, more time spent on social media daily was associated with poorer mental health ($\beta = 0.07$, $p < 0.001$). The variables concerned with social media use accounted for 12.0% of the GHQ variance. Among the sociodemographic (control) variables, better mental health was associated with higher age, male gender, having higher education and having employment.

Between the four countries, the associations between social media use and mental health were relatively uniform, but with

varying effect sizes and probability measures. The association between higher endorsement of the personal contact motive and better mental health was only significant among the participants from USA. The decrease loneliness motive was more strongly associated with poorer mental health among participants from USA and Norway, compared to participants from UK and Australia. The entertainment motive was more strongly associated with poorer mental health among participants from UK and Norway, while less strongly associated among participants from the USA. The maintaining relationships motive was weakly, but significantly associated with better mental health among participants from USA, UK and Norway. Higher endorsement of the social skills compensation motive was associated with poorer mental health only among participants from Norway. The social inclusion and meeting people motives were not significantly associated with mental health among participants in any of the countries. More time spent on social media during a typical day was significantly associated with poorer mental health only among the participants from USA. The social media variables accounted for varying proportions of GHQ variance between the countries: between 7.8% in the UK and 17.6% in Australia.

DISCUSSION

The aims of this study were to examine the associations between social media use and mental health in the general population 9 months after the COVID-19 pandemic outbreak, and to examine mental health in relation to motives for- and time spent on social media use, while adjusting for sociodemographic variables. In the adjusted model for the whole sample, poorer mental health

was associated with using social media to decrease loneliness and for entertainment motives, while better mental health was associated with using social media for personal contact and maintaining relationships. Overall increased daily time on social media was associated with poorer mental health. These findings were relatively consistent across the countries that participated in the survey, with only minor variations. In sum, we found that motives for and time spent on social media use were responsible for a substantial proportion of the variance explained in the sample's mental health 9 months into the COVID-19 pandemic.

Clearly, social media is an important part of many people's lives. Currently, it is estimated that more than 1.8 billion people use Facebook on a daily basis (38), while the corresponding numbers for Instagram and Twitter are 1.1 billion (39) and 192 million (40), respectively. Although the popularity of different social media platforms varies over time and across countries, social media use in general is on the increase (11, 41). This gives rise to questions of the kinds of values that social media bring about for its users.

Our finding, that high daily use of social media was associated with poorer mental health, corresponds with other research in the field (42, 43). Recent studies show that this pattern is also found in the current context of the pandemic (9, 13, 16, 17, 20, 44–47). These findings may lead to the assumption that social media use—in itself—may be detrimental to mental health. However, a reversed causality is equally possible. Poor mental health may lead to more time spent on social media.

Social media use is complex, including the relations between motives for use and mental health. Our study showed that poorer mental health was associated with using social media to decrease loneliness and for entertainment purposes. In contrast, better mental health was associated with using social media for personal contact and maintaining relationships motives. These differences in motives can be seen to coincide with the distinctions between passive and active social media use (26, 48–50). Examples of passive use of social media are scrolling through news feeds or browsing photographs of friends. Passive use of social media has been associated with negative mental health outcomes, including depression, fatigue and a reduction in psychological well-being (26, 49). Active social media users, on the other hand, share life experiences, create text, and respond frequently to other users (50). According to Lin and co-workers (48), active users often experience higher social support, which helps them to have a more favorable attitude toward themselves. The results of our study, that better mental health was associated with using social media for personal contact and maintaining relationships correspond to these findings. On the contrary, the use of social media for the purposes of decreasing loneliness and for entertainment, fits with a passive user profile and is therefore logically related to poorer mental health outcomes.

A concern raised is that passive use of social media seems to dominate (24, 51). This suggests that many people spend much of their time on social media engaging in behavior that may undermine their well-being. A timely question is why this may be the case. There is a growing literature that suggests that social media have addictive properties (41, 49). An element of addiction may explain why some people behave in ways they realize can be

harmful to themselves. Also, it may be possible that some social media users are not aware of the negative implications. According to Lisitsa et al. (24), the current pandemic and the combination of more social media use and well as higher stress levels, are likely to encourage avoidance behaviors, such as passive scrolling rather than active engagement with others online. In particular, this may be the case for young adults, who engage more with social media than people in older age groups. Also, passive users of social media may be more susceptible to the negative mental health effects related to the spread of misinformation and fake news that are currently circulated amongst their social media networks (11, 16, 46).

The complex relationships between social media use, its motives and mental health imply no easy solutions. On the one hand, this study provides support for the notion that extensive use of social media is related to poorer mental health. On the other hand, the relation between social media use and mental health appears to be contingent on how and why social media is used. Therefore, to support mental health, critical questions for self-reflection among social media users may go beyond the “how much” question to include inquiry into the “for what purpose(s).” Social media are not inherently bad, but as they contribute to shape people's lives, a critical, self-reflective stance toward their use is required.

STUDY LIMITATIONS

Respondents were invited to participate through electronic social media. With social media being an aspect for individuals to potentially engage with others, the responses are not inclusive of individuals that do not utilize social media. As also seen from the skewed gender distribution, the sample included in the study is therefore not representative of the general population. This limits the ability to generalize the results to the general population.

A limitation of the study is that we did not take into consideration that already established mental health problems could exacerbate problems related to social distancing measures during the pandemic, with possible consequences for the use of social media. Also, a limitation of our study is that the estimation of time spent using social media is based on self-report only, which does not necessarily reflect actual time spent on social media. It is important to note that the associations between social media use and mental health may be moderated by variables such as social- or community support, cohabitation status and employment. In addition, it is possible that those with higher levels of social capital and support may rely less on social media than people in other segments of the population. Thus, future studies may investigate these associations within and between specified population subgroups. Future studies may also use more targeted self-report measures, related for example to depression and anxiety, to obtain information about mental health.

Due to the cross-sectional design of the study, we do not know whether those who often used social media to reduce loneliness had already improved in their mental health, or if social media use had exacerbated their psychological distress. Future studies that use a longitudinal design can provide data on

changes in psychosocial health within the same people following social media use. In addition, future studies that evaluate mental health interventions in light of COVID-19-related restrictions are needed to address the increased depression and anxiety observed across populations due to the pandemic. A final point is that future studies including other countries and populations would be valuable, as associations between social media use and mental health may vary between different contexts.

CONCLUSION

The individual's motives for using social media and the time spend on social media is associated with one's mental health. Using social media as a coping strategy during restrictions to maintain human relationships appears to be related to better mental health. However, when individuals use social media for entertainment or to reduce loneliness, higher levels of stress and anxiety emerge. The more time spent on social media regardless of the motive for using social media was associated with poorer mental health outcomes. Guidance and recommendations for social media usage to the general public for prevention and intervention for behavioral health may be beneficial.

DATA AVAILABILITY STATEMENT

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

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ETHICS STATEMENT

The studies involving human participants were reviewed and approved by OsloMet (20/03676) and the Regional Committees for Medical and Health Research Ethics (REK; ref. 132066) in Norway, reviewed by the University of Michigan Institutional Review Board for Health Sciences and Behavioral Sciences (IRB HSBS) and designated as exempt (HUM00180296) in USA, by Northumbria University Health Research Ethics (HSR1920-080) in UK, and (HSR1920-080 2020000956) in Australia. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

HT, TB, MS, MR, DP, JL, and AG: conceptualization, methodology, validation, investigation, and writing—review and editing. HT and TB: formal analysis and writing—original draft preparation. TB and AG: data curation. AG: project administration. All authors contributed to the article and approved the submitted version.

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Pandemic-Related Challenges and Organizational Support Among Personnel in Canada's Defense Establishment

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In the final week of March 2020, 2.8 million Canadians were away from their usual places of work and engaging in remote and/or telework to mitigate the spread of COVID-19 (Statistics Canada, 2020). The Government of Canada's Department of National Defence (DND) and the Canadian Armed Forces (CAF) were no exception, with most members from the regular force (Reg F), the primary reserve force (P Res), and the DND public service (DND PS) working from home. The COVID-19 Defence Team Survey was administered from April 29th, 2020, and May 22nd, 2020, to gain insight into work, health, and family-related challenges since the onset of the pandemic and change in work arrangements. Responses from five open-ended questions were qualitatively analyzed to determine general themes of concern regarding work, personal, and family related challenges, stress-management and coping strategies, and recommendations for improving the work situation and personal well-being. Given the different roles and conditions of employment, responses of the different groups or "components" of respondents (Reg F, P Res, DND PS) were compared to identify common and unique challenges to inform targeted organizational responses. A total of 26,207 members (Reg F = 13,668, 52.2%; P Res = 5,052, 19.3%; DND PS = 7,487, 28.6%) responded to the survey's five open-ended questions, which yielded a total of 75,000 open-ended responses. When asked about work-related challenges, respondents' most common challenges included dissatisfaction with technology/software, work arrangements, ergonomics, work-life balance, communication within the organization, and the uncertainties regarding career development. In terms of personal and/or family-related challenges, the most common challenges included social isolation, the impact of the pandemic on mental health, school closures and homeschooling, caring for vulnerable family members, and childcare concerns. The most common stress-management and coping strategies included exercise, spending time outdoors, communicating or spending time with family members, household chores/projects, mind-body wellness exercises, and playing games. The most common recommendations made by respondents to improve their work- or personal-related situations included improving technological capabilities, streamlining communication, providing hardware and software necessary to ensure comfortable ergonomics, the provision of flexibility in terms of telework schedules,

return-to-work decisions, and the expansion of benefits and access to childcare services. In terms of differences among the components, DND PS personnel were most likely to report dissatisfaction with technological changes and ergonomics, and to recommend improving these technological limitations to maximize productivity. Reg F members, on the other hand, were most likely to recommend increased support and access to childcare, and both Reg F and P Res members were more likely to mention that increased benefits and entitlements in response to the COVID-19 pandemic would be ameliorative. The results of this study highlight several important facts about the impact of the COVID-19 pandemic on personnel working in large, diverse organizations. For example, advancements in organizational technological capabilities were highlighted herein, and these are likely to grow to maintain productivity should remote work come to be used more extensively in the long-term. This study also highlighted the importance of flexibility and accommodation in relation to individual needs – a trend that was already underway but has taken on greater relevance and urgency in light of the pandemic. This is clearly essential to the organization's role in supporting the well-being of personnel and their families. Clear and streamlined communication regarding organizational changes and support services is also essential to minimize uncertainty and to provide useful supports for coping with this and other stressful situations.

Keywords: military, COVID-19, pandemic, organization, work-life balance

INTRODUCTION

The COVID-19 pandemic has been a devastating event with revolutionary implications for Canadians and the world. At the time of writing of this manuscript, over 4.75 million individuals worldwide have died due to complications caused by this virus (1), of which 27,695 deaths occurred in Canada alone (1). In addition, the majority of Canadians were subjected to restrictive measures to reduce the spread of the virus, including stay-at-home orders and the closure of schools, daycares, and non-essential businesses (2). While these measures were necessary, they have also resulted in prolonged periods of social isolation; an economic crisis comparable to that of the 2008 recession (3–6); heightened rates of unemployment across a broad range of sectors (6, 7); and an unprecedented proportion of Canadians working from home [$\sim 32\%$ of Canadians, compared to $\sim 4\%$ before the onset of the pandemic; (7–10)].

Like most Canadian organizations, military and national defense establishments were affected by the COVID-19 pandemic. The majority of civilian personnel within the Department of National Defence (DND) and military personnel in the Canadian Armed Forces (CAF) were required to suddenly and quickly work from their homes through telework, remote work, and alternative work arrangements at unprecedented levels (11–15). DND and CAF personnel were likely to be similarly affected by the various challenges stemming from the pandemic, such as concerns over health and safety, social isolation, reduction in the availability of important services, and concerns over the well-being of children and other loved ones. As such, the DND/CAF developed empirical research to help understand the challenges and experiences of their personnel

in order to inform organizational approaches to address these issues and support its personnel. This article presents the findings of this research, focusing on DND/CAF civilian and military personnel's challenges with, and adjustment to, the COVID-19 pandemic, particularly in relation to their work and personal well-being.

To date, many studies have assessed how civilian workers have adjusted to working from home, particularly from a productivity standpoint. Fortunately, this research has consistently found that workers have “adjusted well” to work-related changes. Nine in 10 workers working from home in Canada reported being at least as productive as when they worked in their usual location (9), mirroring those working from home in the United States (16, 17) and the United Kingdom (18, 19). Workers have also reported greater autonomy, reduced occupational stress, and increased motivation for their work while working from home (20, 21). Furthermore, individuals working from home were spared some of the concerns of those who were not able to work from home (i.e., frontline and essential workers), including a heightened fear of COVID-19 transmission (22, 23), dissatisfaction with safety precautions in the workplace (23), and lack of access to personal protective equipment (24, 25). Despite these benefits, surveys of Canadians working from home found that equal proportions wanted to return to pre-pandemic work arrangements, continue to work from home permanently, or adopt a hybrid approach (9, 17, 19).

This variability suggests that there have been various challenges to employees' productivity and well-being at work that must be acknowledged and understood. Researchers have warned that working from home, telework, and alternative work arrangements can have adverse consequences if they are

mandatory (26). These potential challenges include organization unpreparedness, communication challenges and job sharing limitations, and the unsuitability of working from home for certain workers (26, 27). Such challenges can foster toxic relationships and dissatisfaction in the remote workspace (26–28). Indeed, since the onset of the pandemic, Canadians working from home reported that isolation from co-workers, limited access to work-related resources/information, unsuitable ergonomic arrangements, and technological limitations (e.g., software/hardware unavailability, slow internet speed) acted as barriers to their work-related well-being and productivity (9, 24, 28). These challenges were mirrored in other countries as well, along with technological limitations (29), communication challenges with co-workers (29–31) and managers/senior leaders (29), and unsuitable ergonomics (32–34). Employees also reported disruptions in work-life balance (29, 35–38). These disruptions could be due to a greater inability to disconnect from one's work, a lack of distinction between one's work environment and home environment, working longer hours, and higher workloads (9, 28, 29, 39), and personal insecurity about one's productivity and performance (29, 30, 40).

The personal and family health of personnel has also suffered because of the pandemic. Many individuals, both in and outside of Canada, have reported decreases in their mental health, feelings of loneliness, anxiety, depression, panic, and overall psychological distress (41–48). There has also been an increased prevalence of burnout in those working from home (35, 49). Furthermore, studies have highlighted reduced opportunities and options for physical exercise, resulting in increased sedentary behavior (50–54) and limited options to cope and maintain one's physical health amid the pandemic (55). Given that most families have been confined to their homes and isolated from friends and extended family, there may also be negative impacts on familial well-being, including increased family conflict, dissatisfaction, and even violence (56–60), particularly when there is financial stress on the household (61) or for those facing substance use issues (57). Finally, homeschooling and constant childcare have also been incredibly demanding, leading to further infringement of work-life balance and leaving little room for leisure and entertainment (62, 63).

A minimal amount of research has examined adjustments of military personnel to the COVID-19 pandemic (64), and existing research has focused mainly on mental health outcomes (64). Therefore, the current study examines a broad range of challenges to both work and personal well-being among CAF military personnel, and compares these to civilian personnel working from the DND using the COVID-19 Defence Team Survey, administered in the spring of 2020. This survey was designed to “better understand Defence Team members' experiences and needs related to the COVID-19 pandemic, with a view to identify organizational approaches for supporting personnel and their families today and in the future” [(15); p. 1]. Over 27,000 members of the DND/CAF responded to this survey of more than 60 close-ended questions, highlighting the myriad challenges during the COVID-19 pandemic (15). While previous work has presented the findings from the close-ended survey responses, respondents of the COVID-19 Defence Team Survey also

provided input on several core issues in their own words through their answers to five open-ended questions. Given that the scale of the pandemic and the response to it are unprecedented in recent times, these open-ended questions were created to tap into potentially unrecognized and unpredictable elements that may not have been covered by the close-ended survey questions. In addition to assessing challenges and concerns, these open-ended questions probed coping approaches and what the organization could do to support its employees. Here, we report on the findings from the analysis of employees' responses to these open-ended questions to complement the insights uncovered using close-ended questions.

Research has also shown that the effects of the pandemic can vary as a function of individual characteristics, including gender, age, ethnicity, income, and family status (22, 23, 65), and may depend on the type of work and employment sector individuals engage in (22, 28). As a result, one could surmise that personnel from different groups in DND/CAF may differ in terms of the dynamic work and personal consequences of the pandemic. Three broad subgroups or *components* of personnel comprising the DND/CAF Defence Team are regular force (Reg F) military personnel, Primary Reserve Force (P Res) military personnel, and DND civilian Public Service (DND PS) personnel. Reg F military personnel serve the CAF in a full-time manner as a profession. Primary reservists are military members who are generally employed by the armed forces to complement or supplement regular force military capacity, often on a part-time basis, while also being employed in the civilian labor market (66, 67). DND PS personnel perform a wide variety of tasks and are found in many different occupations within defense establishments, including administrative support, technical, scientific, and professional positions (68). Civilians are also often employed within senior leadership and executive roles, sharing the responsibility for the management and leadership of defense establishments with their military counterparts (69, 70). In light of the systemic differences between components, the current study also compared the primary concerns of personnel from these respective components. Ultimately, the insights observed in this study are intended to help inform organizations—both military and civilian—to identify and understand challenges to their personnel's well-being and productivity, explore how these might vary across different segments of the workforce, and shed light onto approaches that might be used to address these challenges throughout the ongoing pandemic and in response to potential future crises.

METHOD

In the context of a comprehensive survey battery comprising closed-ended items, the COVID-19 Defence Team Survey also included five open-ended questions asking respondents to share their perceptions and experiences in their own words (15, 71). The survey was accessible to all members of the DND/CAF via the internet. Announcements about the survey were sent through the official DND/CAF website, organizational social networking platforms (e.g., Facebook, Twitter), and emails from

TABLE 1 | Demographics.

	Whole sample	Reg F	P Res	DND PS
Gender				
Male	18,877 (72.0)	11,152 (82.0)	4,031 (80.1)	3,694 (49.7)
Female	6,926 (26.4)	2,285 (16.8)	952 (18.9)	3,689 (49.6)
Other	52 (0.3)	30 (0.2)	11 (0.2)	12 (0.2)
Prefer not to say	213 (0.8)	137 (1.0)	37 (0.7)	39 (0.5)
Missing	138 (0.5)			
Age				
24 years and under	3,432 (13.1)	1,644 (12.1)	1,638 (32.5)	150 (2.0)
25–34 years	6,959 (26.6)	4,719 (34.6)	1,377 (27.3)	863 (11.6)
35–44 years	6,637 (25.3)	4,114 (30.2)	777 (15.4)	1,746 (23.5)
45–54 years	5,828 (22.2)	2,552 (18.7)	828 (16.4)	2,448 (32.9)
55–64 years	3,025 (11.5)	597 (4.4)	423 (8.4)	2,005 (27.0)
65 years and over	224 (0.9)	4 (<0.1)	1 (<0.1)	219 (2.9)
Missing	102 (0.4)			
Number of children (17 years and under)				
0	3,408 (13.0)	1,520 (78.5)	842 (80.0)	1,046 (86.3)
1	306 (1.2)	149 (7.7)	93 (8.8)	64 (5.3)
2	247 (1.2)	124 (6.4)	67 (6.4)	56 (4.6)
3	151 (0.6)	86 (4.4)	30 (2.9)	35 (2.9)
4	49 (0.2)	32 (1.7)	11 (1.0)	6 (0.5)
5	18 (0.1)	12 (0.6)	2 (0.2)	4 (0.3)
6+	22 (0.1)	14 (0.7)	7 (0.7)	1 (0.1)
Missing	22,006 (84.0)			
First official language				
English	18,420 (70.3)	9,369 (69.0)	3,917 (78.0)	5,134 (69.2)
French	7,594 (29.0)	4,203 (31.0)	1,108 (22.0)	2,283 (30.8)
Missing	193 (0.7)			
Marital status				
Single (never married)	8,023 (30.6)	4,207 (30.9)	2,661 (52.8)	1,155 (15.6)
Separated/divorced	2,035 (7.8)	992 (7.3)	284 (5.6)	759 (10.2)
Widowed	128 (0.5)	34 (0.2)	17 (0.3)	77 (1.0)
Married/Common-law	15,907 (60.7)	8,400 (61.6)	2,076 (41.2)	5,431 (73.2)
Missing	114 (0.4)			
Province/territory of residence				
National Capital Region (NCR)	6,396 (24.4)	2,256 (16.5)	479 (9.5)	3,661 (49.0)
British Columbia	2,326 (8.9)	1,280 (9.4)	674 (13.4)	372 (5.0)
Alberta	1,344 (5.1)	964 (7.1)	86 (1.7)	294 (3.9)
Saskatchewan	256 (1.0)	127 (0.9)	95 (1.9)	34 (0.5)
Manitoba	897 (3.4)	560 (4.1)	174 (3.5)	163 (2.2)
Ontario (outside NCR)	5,936 (22.7)	3,497 (25.6)	1,148 (22.8)	1,291 (17.3)
Quebec (outside NCR)	4,262 (16.3)	2,336 (17.1)	907 (18.0)	1,019 (13.6)
New Brunswick	1,641 (6.3)	1,018 (7.5)	485 (9.6)	138 (1.8)
Nova Scotia	2,055 (7.8)	1,087 (8.0)	549 (10.9)	419 (5.6)
Newfoundland and Labrador	514 (2.0)	152 (1.1)	313 (6.2)	49 (0.7)
Prince Edward Island	119 (0.5)	8 (0.1)	110 (2.2)	1 (<0.1)
Northern Canada (Nunavut, Northwest Territories, Yukon)	42 (0.2)	29 (0.2)	9 (0.2)	4 (0.1)

(Continued)

TABLE 1 | Continued

	Whole sample	Reg F	P Res	DND PS
Other (outside of Canada)	362 (1.4)	333 (2.4)	8 (0.2)	21 (0.3)
Missing	57 (0.2)			
Rank				
Junior NCM	9,683 (36.9)	6,622 (48.6)	3,061 (60.9)	
Senior NCM	4,102 (15.7)	3,226 (23.7)	876 (17.4)	
Junior officer	2,763 (10.5)	2,082 (15.3)	681 (13.5)	
Senior officer	2,111 (8.1)	1,700 (12.5)	411 (8.2)	
Missing	7,458 (28.8)			
Years of service in the CAF				
<1 year	1,403 (5.4)	512 (3.8)	434 (8.6)	457 (6.1)
1–5 years	6,570 (25.1)	2,994 (21.9)	1,958 (38.8)	1,618 (21.7)
6–10 years	3,603 (13.7)	2,254 (16.5)	726 (14.4)	623 (8.4)
11–15 years	4,646 (17.7)	2,755 (20.2)	471 (9.3)	1,420 (19.1)
16–20 years	3,203 (12.2)	1,972 (14.5)	307 (6.1)	924 (12.4)
21–25 years	2,935 (7.4)	1,201 (8.8)	266 (5.3)	468 (6.3)
26 years and over	4,776 (18.2)	1,954 (14.3)	882 (17.5)	1,940 (26.0)
Missing	71 (0.3)			

Table presents the number of respondents (and percentage of respondents in brackets) who meet the demographic criteria. Reg F, Regular Force members; P Res, Reservists in the Primary Reserve; DND PS, Personnel in the public service of the Department of National Defence; NCM, Non-commissioned officer; CAF, Canadian Armed Forces.

senior managers and leaders. The majority of personnel learned about the survey from their chain of command (86% of Reg F, 87% of P Res, and 70% of DND PS personnel). All responses collected within 4 weeks of survey administration from April 29th, 2020, to May 22nd, 2020 were used in the present analysis.

Sample and Demographics

A total of 27,140 DND/CAF personnel completed the survey. The current study focuses on Reg F, P Res, and DND PS personnel, which comprised 26,207 participants (96.6% of the entire sample). The majority of respondents were Reg F ($n = 13,668$; 52.2%), while a fifth were P Res members ($n = 5,052$; 19.3%), and a third were DND PS personnel ($n = 7,487$; 28.6%), which reflects the actual DND/CAF Defence Team in this regard (72).

A summary of the demographic information among the whole sample and for each specific component is presented in **Table 1**. Overall, the majority of the sample was male; between 25 and 44 years of age; English speaking; lived in either the National Capital Region (Ottawa/Gatineau), Ontario (outside of the National Capital Region) or Quebec (outside of the National Capital Region); were married or in a common-law relationship; and did not have any children. The majority of military respondents (Reg F and P Res) were junior or senior non-commissioned members and were not currently deployed on an operation. The most commonly reported years of service within the CAF were 1–5, 11–15, and 26 years and above. Some demographic differences were noted between components. For

instance, CAF personnel (Reg F and P Res) were mostly male, while DND PS personnel were equally split into male and female respondents. Military personnel were also more likely to be under 35 years of age, whereas DND PS personnel were more likely to be between the ages of 35 and 64. P Res members were less likely than DND PS and Reg F members to be married, and DND PS members were more likely to be from the National Capital Region, while military personnel were relatively evenly distributed across Canadian regions. This too reflects the actual differences among the DND/CAF Defence Team population (71).

Overall, compared to population parameters of DND/CAF personnel, the resulting sample was representative of the population across key demographic variables. The only exception was a slight underrepresentation of junior non-commissioned members.

Materials

The COVID-19 Defence Team Survey was developed by the Director General Military Personnel Research and Analysis (DGMPPRA) unit of DND/CAF based on the information available about the pandemic and its potential effects on personnel, as well as consultations with organizational stakeholders (e.g., leaders and mental health experts in DND/CAF). The work of other departments within the Government of Canada was also consulted (e.g., Treasury Board Secretariat; Privy Council Office; Environment and Climate Change Canada; Innovation, Science, and Economic Development Canada) and, in particular, Statistics Canada's Canadian Perspectives Survey Series [CPSS; (45, 73–76)] and Impacts of COVID-19 on Canadians: Data Collection Series (76). Finally, COVID-19 research initiatives being carried out by allied military organizations were also considered when developing the survey.

Overall, the survey consisted of over 60 questions, five of which were open-ended questions that are the focus of this paper. These open-ended questions were used to query respondents on the following key themes: work-related challenges, personal and family-related challenges, stress management strategies, organizational support related to work, and organizational support for personal and family needs.

Analysis of Qualitative Data

Over 75,000 responses to the five open-ended questions were obtained. A third-party coded and summarized the results following the approach delineated by DGMPPRA (Human Resource Systems Group, Ltd.; see section Acknowledgments). In particular, responses for each question were coded using thematic analysis and summarized for the sample overall and for each of the components separately (i.e., Reg F, P Res, and DND PS). Some responses were complex and consisted of multiple themes. All responses were coded into all relevant themes such that complex responses that contained more than one theme were coded into each applicable theme. Given this, the total number of coded responses for each question exceeds the number of survey respondents. Responses that were deemed “Not Applicable” were removed from further analysis. It was decided to report on the seven most commonly-cited themes in

response to each question, as these represented the majority of the coded themes and thus captured the most notable themes. The full set of themes in response to each question are presented in **Supplementary Tables 1–5**.

RESULTS

Work-Related Challenges

The first open-ended question asked respondents, “What are the most significant work-related challenges you have been experiencing since the start of the COVID-19 pandemic?” A total of 19,139 respondents (9,173 Reg F, 3,998 P Res, and 5,968 DND PS members) responded to this question. Twenty-nine themes (**Supplementary Table 1**) were extracted from statements, and 522 statements were deemed “Not Applicable.” The seven most common themes in response to this question included (1) *dissatisfaction with technology/software*, (2) *dissatisfaction with one's working arrangement*, (3) *ergonomic or work equipment/resources*, (4) *work and life/family balance concerns*, (5) *communication challenges*, (6) *increases in work volume*, and (7) *effects on career development* (see **Figure 1**).

The first three themes focused on material limitations to establish an appropriate workspace in the home and successfully work from home. The most commonly-reported theme was *dissatisfaction with technology/software* and was reported by $n = 5,038$ (27.1%) respondents. Responses in this theme centered on challenges in accessing work-related email and software, connecting to the organization's virtual private network (VPN), and insufficient IT support. The second most common theme was *dissatisfaction with working arrangements* ($n = 3,810$, 20.5% of respondents), including challenges related to the transition to working from home, a perceived lack of productivity, lack of motivation, disruptions in routine, distractions making it difficult to focus on work, and requirements for new and unknown skills to successfully work from home. For instance, one respondent noted that “It takes days to do what could be done in minutes at the office.” The third most common theme was *ergonomics of work equipment/resources* ($n = 2,659$, 14.3% of respondents), which entailed respondents' physical or functional discomfort of their new work environment due to concerns, such as insufficient office space, office furniture, and hardware.

The fourth most common theme highlighted disruptions in *work and life/family balance* ($n = 2,439$, 13.1% of respondents). Comments within this theme highlighted the challenge of balancing work-related responsibilities, home/childcare responsibilities, and the need for leisure, entertainment, and relaxation. Respondents also noted that these difficulties directly resulted from working while confined to their home with their family, and that they were experiencing a toll on their well-being due to a lack of separation of work and personal domains (e.g., having to be constantly accessible for work).

The fifth most common theme was *communication challenges* ($n = 2,155$, 11.6% of respondents), highlighting dissatisfaction with various aspects of work-related online communication, rules and regulations relating to the ongoing pandemic, and the organization's decisions to address the ever-evolving situation of the COVID-19 pandemic. This theme also included reports on

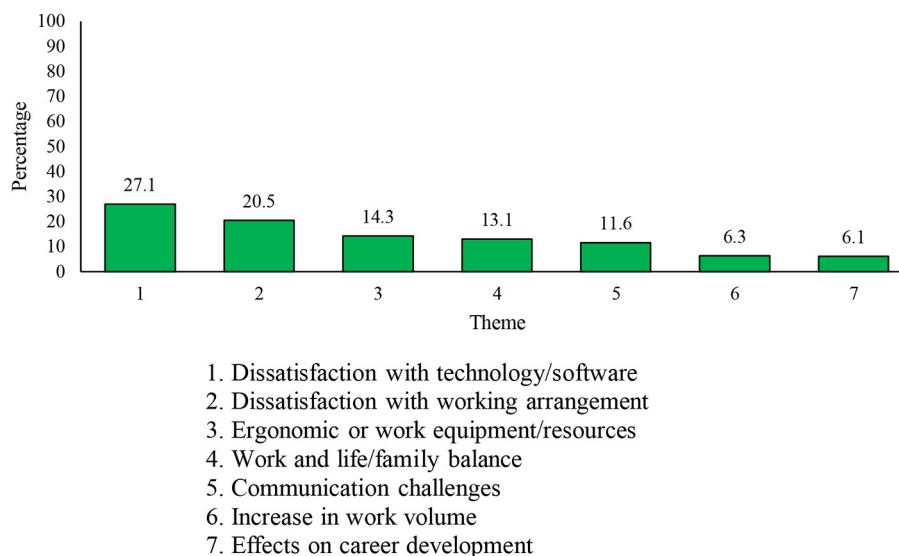


FIGURE 1 | Seven most frequently mentioned work-related challenges.

difficulties contacting peers, subordinates, and supervisors, and delayed responses from peers and supervisors as a result of being limited to online rather than in-person interactions.

The sixth theme was an *increase in work volume* ($n = 1,177$, 6.3% of respondents), and included comments related to increases in work volume, reduced staff/manning, new tasks or demands stemming from the pandemic, and a generally high work volume. Some of the comments coded within this theme pertained to the respondents' reduced capacity while working from home, difficulties getting work done in time, burnout resulting from greater workloads, and difficulties delegating work.

The seventh most reported theme was *effects on career development* ($n = 1,144$, 6.1% of respondents). Responses categorized in this theme related to a variety of concerns regarding career development, such as lack of recognition for increased work or tasks, uncertainty about the respondent's training and education, and general concerns about career progression and promotion.

The most notable differences observed between components, as shown in **Figure 2**, were that DND PS members were substantially more likely to report *dissatisfaction with technology/software*, issues relating to *ergonomic or work equipment/resources*, and were somewhat more likely to report *communication challenges*. Military members on the other hand, including those from the P Res and the Reg F, were more likely to report concerns of *career development*.

Personal and Family-Related Challenges

The second open-ended question asked respondents "What are the most significant personal and family-related challenges you have been experiencing since the start of the COVID-19 pandemic?" A total of 18,544 respondents (9,006 Reg F, 3,790 P Res, and 5,748 DND PS members) provided an answer to

this item. Two-hundred and thirty-eight responses were coded as "Not Applicable." Thirty-one themes were coded from valid responses to this question, with the seven most common being (1) *social isolation*, (2) *mental health*, (3) *school closures and homeschooling*, (4) *parents/elderly family members*, (5) *loved-ones contracting COVID-19*, (6) *childcare concerns*, and (7) *work-life balance* (see **Figure 3**).

The *social isolation* theme ($n = 7,089$, 38.7% of respondents) was the most cited theme and included comments related to limited gatherings with family members, friends, and co-workers; a general lack of social gatherings; lack of public entertainment and social events; and an inability to travel. Sample comments include "Missing the human contact and interaction at work" or "Unable to reunite with my partner who lives outside of the (National Capital Region)." Some comments also included the emotional toll that these restrictions were taking, such as increased loneliness (e.g., "Living alone, I'm very lonely!").

The second most common theme in response to this question related to respondents' *mental health* ($n = 2,438$, 13.3% of respondents). Respondents mentioned several negative consequences the pandemic and social changes had on their mental health and well-being. Such consequences included increases in anxiety, depression, irritability, impatience, burnout, boredom, and difficulties remaining motivated to work.

Two themes highlighted the challenge and stress of having to balance work and childcare during the pandemic. The third most common theme in response to this question was *school closures and homeschooling* ($n = 2,208$, 12.1% of respondents), which included comments noting the difficulty balancing childcare and work, carrying out homeschooling effectively, and ensuring quality education for the respondents' child(ren). Respondents also commented on the stress and mental health toll of this added challenge (e.g., "Homeschooling my three young children causes me no end of stress"). Moreover, homeschooling was discussed as

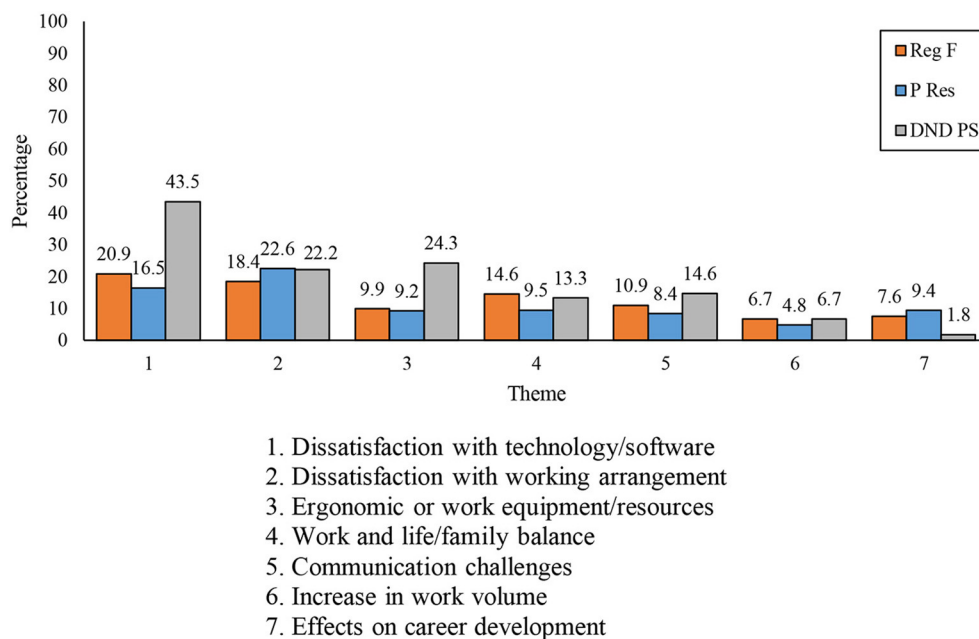


FIGURE 2 | Seven most frequently mentioned work-related challenges by component.

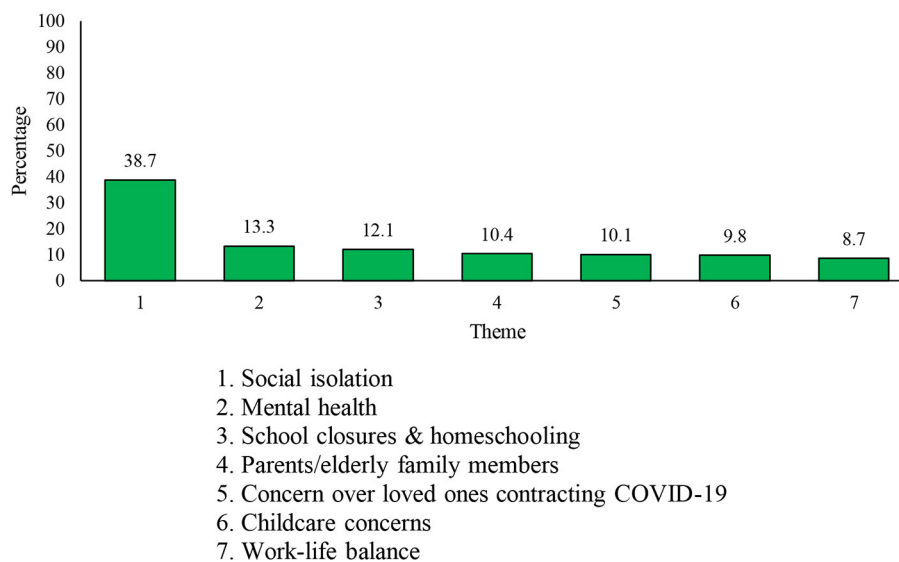


FIGURE 3 | Seven most frequently mentioned personal and family-related challenges.

particularly challenging when considering children's individual dispositions or needs, such as learning disabilities. Relatedly, in the sixth most common theme, respondents reported *childcare concerns* ($n = 1,792$, 9.8% of respondents), such as concerns regarding the financial obligations of childcare, the inaccessibility of regular and emergency childcare, and lack of support for children with special needs.

The fourth most common theme evinced concerns for *parents/elderly family members* ($n = 1,904$, 10.4% of respondents),

which consisted of comments noting stress and concern for family members, the need to provide care and support to medically vulnerable and elderly family members, and worrying about their susceptibility to COVID-19 complications (e.g., "My parents are in the age category that puts them at risk. I am concerned for their well-being"). Some respondents also reported stress and frustration with ensuring the compliance of their family members with COVID-19 restrictions. For instance, one respondent noted "I am having to manage my parents, to

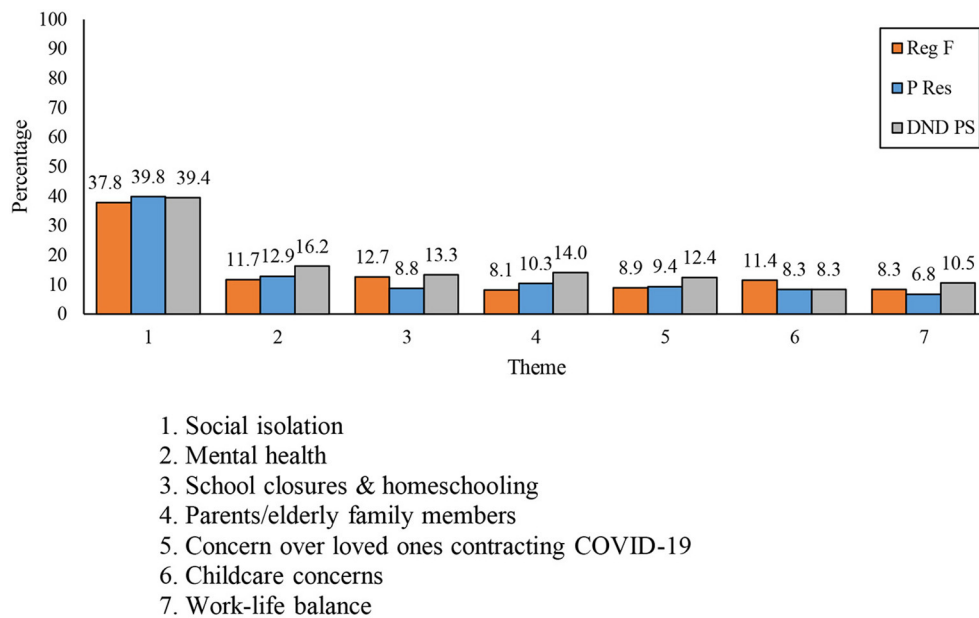


FIGURE 4 | Differences between components of respondent in the frequency of the seven themes mentioned.

make sure they don't go out, and making sure they have what they need." Another noted that "Trying to explain why social distancing and isolation is required with older family members that don't understand it."

Relatedly, the fifth most common theme highlighted anxieties regarding the health of loved ones amid the severity of the pandemic. This theme, *concern over loved one contracting COVID-19* ($n = 1,848$, 10.1% of respondents), included comments centering on the fear of a close loved one contracting the virus, the vulnerability of loved ones working as essential workers and first-responders in compromised spaces, and the risks posed by such circumstances to vulnerable family members. For example, one respondent noted "Fearing for the safety of my spouse who is a nurse who has been working (with) COVID patients."

The seventh most common theme was *work-life balance* ($n = 1,590$, 8.7% of respondents) which mirrored the *work and life/family balance* theme extracted when surveyed on work-related challenges (see section Work-Related Challenges). Responses in this theme further highlighted how the increasing demands of working from home, changes in workload, and teleworking have encroached on one's non-work-related endeavors. Many also added that a disrupted work-life balance is contributing to burnout: "Before the pandemic, work stayed at work. Now it is at home. Using my own emails and devices due to departmental challenges has been extremely intrusive to maintaining a work life balance." Another respondent noted "Due to network issues, I've had to change my work hours to be in the evening as well. This means that I am working on and off over a 16-h time period and my personal time is suffering and I'm not able to dedicate much time to my life outside of work."

There were no particularly notable differences in terms of personal and family-related challenges among Reg F, P Res, and DND PS respondents (see **Figure 4**).

Stress Management Strategies

The third open-ended question asked respondents, "What stress management strategy(ies) have you found most helpful to get you through the COVID-19 pandemic?" A total of 17,826 respondents (8,692 Reg F, 3,881 P Res, and 5,253 DND PS) answered this question. One-hundred and seventy-four responses were deemed "Not Applicable." Thirty-eight themes were derived, with the seven most common being (1) *exercise*, (2) *time outdoors*, (3) *spending time with immediate family or pet*, (4) *communicating with friends/family/coworkers*, (5) *household chores/house projects*, (6) *mind-body wellness/relaxation*, and (7) *playing games* (see **Figure 5**). To note, while relatively infrequent (representing < 2% of responses), some of the coping strategies reported may be considered maladaptive, such as drinking alcohol ($n = 259$, 1.5%), cannabis use ($n = 163$, 0.9%), and smoking cigarettes and/or cigars ($n = 44$, 0.2%).

The most commonly reported stress management strategy was *exercise* ($n = 7,125$, 40.9% of respondents), which included any form of physical exercise completed either indoors or outdoors. The second most common strategy, *time outdoors* ($n = 4,750$, 26.9% of respondents), constituted references to spending time outdoors doing a range of activities (e.g., getting fresh air, gardening/yard work, exercise outdoors, being in the sun/nature). The third strategy, *spending time with immediate family or pet* ($n = 2,084$, 11.8% of respondents) included establishing and maintaining quality time with family or pets. The fourth most common strategy, *communicating with friends/family/coworkers* ($n = 1,865$, 10.6% of respondents),

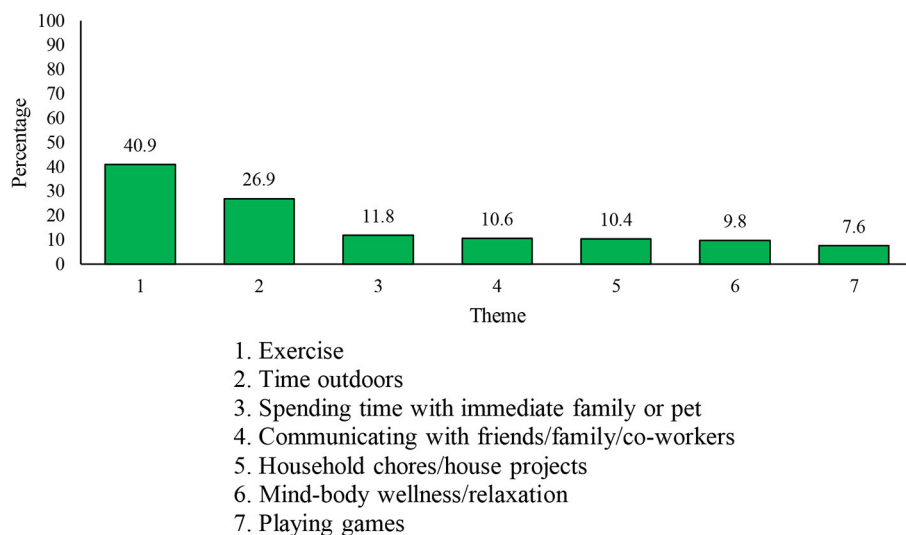


FIGURE 5 | Seven most frequently mentioned stress management strategies.

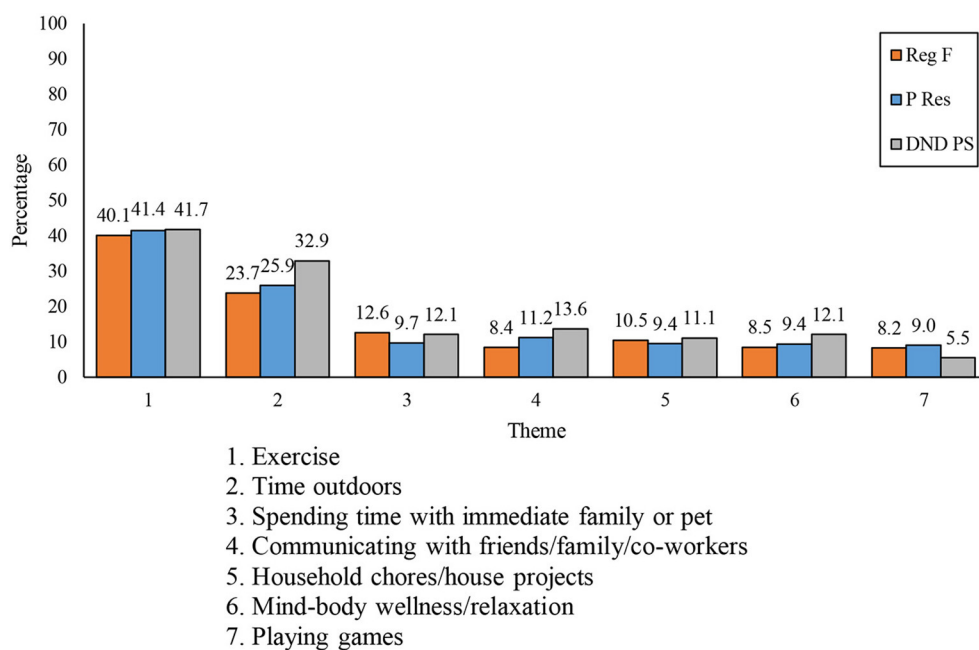


FIGURE 6 | Seven most frequently mentioned coping strategies among each component.

included using technological mediums to connect with others for work or leisure. Completing *household chores/house projects*, including home renovations, was mentioned by $n = 1,843$ respondents (10.4% of respondents). *Mind-body wellness/relaxation* strategies ($n = 1,723$, 9.8% of respondents) was the sixth most commonly-reported coping strategy and consisted of practices, such as relaxation and breathing techniques, yoga, meditation, and mindfulness. The seventh

most common strategy was *playing games* ($n = 1,340$, 7.6% of respondents), which included completing puzzles and playing board games and video games.

The use of these coping strategies was generally similar across personnel from the three components (see **Figure 6**), although DND PS respondents were slightly more likely to indicate spending time outdoors and slightly less likely to indicate playing games as coping strategies.

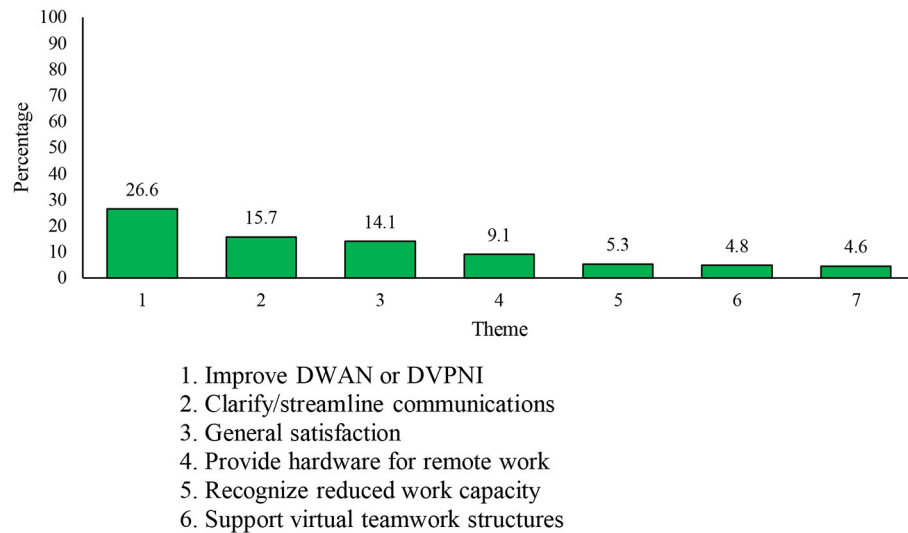


FIGURE 7 | Seven most frequently mentioned themes relating to how the DND/CAF can better support work during the COVID-19 pandemic.

Work-Related Organizational Support

The fourth open-ended question asked respondents “What can the DND/CAF do to better support you with your work during the COVID-19 pandemic?” A total of 9,994 respondents (4,846 Reg F, 1,895 P Res, and 3,253 DND PS) answered this question. Two-hundred and seventy-four responses were deemed “Not Applicable.” Thirty-one themes were derived from responses, the seven most common being (1) *improve IT network*, (2) *clarify/streamline communications*, (3) *general satisfaction*, (4) *provide hardware for remote work*, (5) *recognize reduced work capacity*, (6) *support virtual teamwork structures*, and (7) *flexibility for work location/hours* (see **Figure 7**). The *general satisfaction* theme ($n = 2,582$, 14.1% of respondents) included comments indicating that the respondent was satisfied with the DND/CAF’s efforts to support their work, and most of the comments within this theme (98.3%; $n = 1,348$) did not offer elaboration regarding their satisfaction.

Overall, the most commonly-cited recommendation was to *improve IT network* ($n = 2,582$, 26.6% of respondents). Comments comprising this theme related to the need to rapidly improve the online infrastructure for personnel to access their work-related resources available only via a secured VPN connection. Comments within this theme also highlighted the need to improve network accessibility and bandwidth capacity. To note, some respondents added that the limitations in bandwidth have necessitated that they work outside of their regular work hours, including early in the morning or late into the evening. Respondents also suggested the value of centralized and consistent login credentials, and better integration, across networks within the organization. Finally, respondents suggested the use of rotating shifts or work schedules to improve accessibility to the network.

The second most common recommendation was to *clarify/streamline communications* ($n = 1,527$, 15.7%

of respondents) to ensure easy access to messages and communications for all personnel. Respondents noted that, at the time of the survey, they were oversaturated with information from multiple sources (some of which consisted of conflicting information across sources). Respondents also mentioned that they would appreciate a reduction in communications that they deemed unnecessary and/or abstract. For example, one respondent noted “Streamline communications. There is too much information on too many platforms. I rely on my work email and cell phone for communications normally, but now I have to monitor Zoom, Slack, Google Docs, and my personal email to stay up to date on everything” and “Stop pushing multiple department wide messages and policies that tend to overwhelm the in-box and, because they are departmentally focused, are generally so ambiguous as to mean little or nothing to the individual at the tactical level. DND wide traffic and messages should be focused on concise, brief, highly important or urgent messages.”

The fourth most common theme ($n = 886$; 9.1% of respondents) entailed recommendations that the organization *provide hardware for remote work*. Comments within this theme highlighted a lack of technological, computational, and communication equipment to complete work from home. Provision of ergonomic equipment and office furniture was also recommended. Similarly, the sixth most common theme was labeled *support virtual teamwork structures* ($n = 469$, 4.8% of respondents), which entailed the provision of additional software, IT support, and training to operate virtual team structures (e.g., Microsoft Teams).

The remaining themes entailed ways in which supervisors, senior leaders, and the organization can offer flexibility and understanding to personnel as they cope with the pandemic. In particular, the fifth most common theme, *recognize reduced work capacity* ($n = 519$, 5.3% of respondents), focused on the

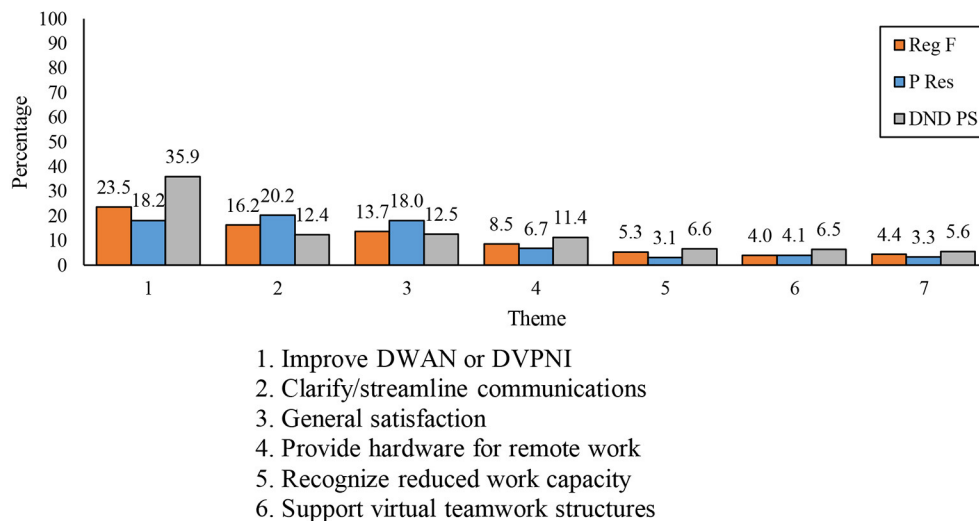


FIGURE 8 | Differences between components in terms of the seven most commonly reported themes on changes the organization could make to support its members' work.

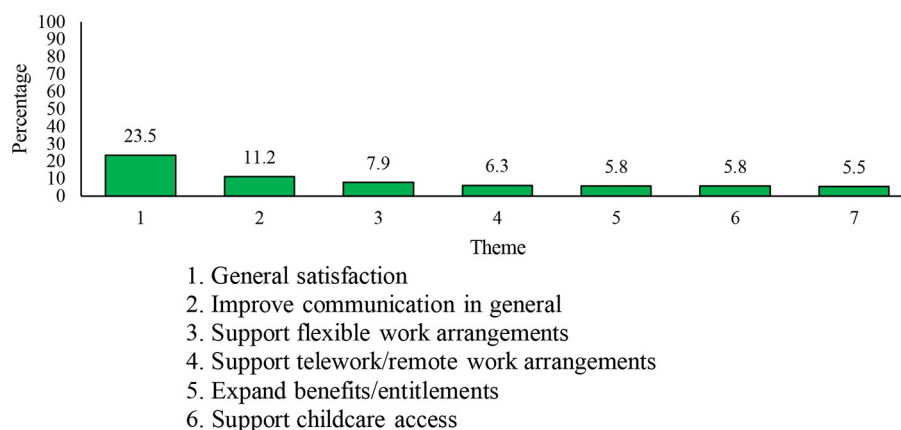


FIGURE 9 | Seven most frequently mentioned themes relating to how the DND/CAF can better support personal and family needs during the COVID-19 pandemic.

need for supervisors and leaders to recognize the difficulties of working from home, and working while caring for children or supporting other family members. Comments also included the notion that this understanding should be applied to performance evaluations. Relatedly, the seventh most commonly cited theme, *flexibility for work locations/hours* ($n = 447$, 4.6% of respondents), related to the need for greater autonomy in return-to-work decisions, flexibility in work hours, and flexibility to accommodate frequently changing and challenging home situations.

Few differences were observed among the components (see **Figure 8**). DND PS personnel were more likely to mention the need to *improve DWAN or DVPNI*, whereas P Res members were the most likely to mention the need for improving communications.

Organizational Support for Personal and Family Needs

The fifth open-ended question asked respondents “What can the DND/CAF do to better support you with your personal and family needs during the COVID-19 pandemic?” A total of $n = 7,105$ respondents (3,729 Reg F, 1,232 P Res, and 2,144 DND PS) answered this question. Three-hundred and ten responses were deemed “Not Applicable.” Thirty-one themes were derived from comments (see **Figure 9**), the seven most common being (1) *general satisfaction*, (2) *improve communication in general*, (3) *support flexible work arrangements*, (4) *support telework/remote work arrangements*, (5) *expand benefits/entitlements*, (6) *support childcare access*, and (7) *consideration for childcare and homeschooling*. The *general satisfaction* theme ($n = 1,597$, 23.5% of respondents) included

comments indicating contentment with DND/CAF's efforts to support their personnel's personal and family-related well-being amid the COVID-19 pandemic. Most responses (96.2%; $n = 1,537$) that contained a comment coded into "general satisfaction" did not contain further comments (i.e., respondents were generally satisfied and had no further suggestions).

The three most common recommendations for personal support mirrored recommendations provided in response to the previous question (section Work-Related Organizational Support). The most common recommendation was to *improve communication in general* ($n = 760$, 11.2% of respondents), which highlighted a need to increase communication lines from senior management/leaders, centralizing and prioritizing communications, and better communication regarding services available to personnel. The second most common recommendation was that leaders *support flexible work arrangements* ($n = 536$, 7.9% of respondents). Comments within this theme related to a desire for greater autonomy and flexibility to decide upon work routines [e.g., allowing individuals leave during regular work hours to handle essential needs (e.g., groceries)], a reduction in work-related activities and meetings, and providing flexibility on return-to-work decisions. The third most common area of support was related to support for telework/remote work arrangements ($n = 426$, 6.3% of respondents), which constituted an expansion of telework roles, providing guidance and training for long-term telework, and increasing support and hardware for telework.

The remaining recommended areas of support were unique to the current question. In particular, the fourth most common recommendation was to *expand benefits/entitlements* ($n = 397$, 5.8% of respondents), including the need to expand and communicate the financial resources available to personnel. In a few cases, this included expanding the definition of supported family and/or dependents to include elderly parents and/or extended family members. Members also desired an expansion of services provided by DND/CAF, notably the inclusion of psychosocial services (i.e., social work).

The remaining two themes, which centered on support for those engaging in home schooling and extended childcare ($n = 394$; 5.8% of respondents), recommended the organization support childcare access. This included an expansion of the services provided by the CAF Military Family Resource Centers, financial assistance for childcare, access to emergency medical childcare, and the implementation of flexible hours to accommodate childcare. Another 371 (5.5%) respondents commented on homeschooling in particular, and recommended reducing the workload for members who were homeschooling children, providing flexibility to workers to accommodate homeschooling responsibilities, and offering appropriate guidance for caring for children and managing homeschooling while working from home.

With respect to differences by component, members from the P Res and DND PS were more likely to note being generally satisfied with the organizational support provided as compared to their Reg F counterparts (see **Figure 10**). By contrast, Reg F members were more likely than P Res and DND respondents

to mention childcare access and expansion of benefits and entitlements as areas with which the organization can offer more support.

DISCUSSION

The COVID-19 Defence Team Survey was developed to provide insight on the challenges faced by civilian and military personnel in the wake of the COVID-19 pandemic and what the DND/CAF organization can do to support its personnel. Considering working arrangements were drastically altered with little notice, work-related and personal/family-related well-being were key areas examined. Moreover, given that the effects of the pandemic may differ depending on individual characteristics (15, 22, 28), and in light of the distinct roles and employment arrangements of Reg F, P Res, and DND personnel, the experiences and concerns of personnel from these three DND/CAF components were compared. In brief, a common aspect of many of the most commonly reported challenges—on both the personal and work front—is that these touch on several aspects of respondents' experiences with having to adjust to working from home, with little time to prepare on both their part or the part of DND/CAF.

Work-Related Challenges

The most commonly reported work-related challenges during the pandemic centered on issues with technology when working from home; lack of proper workspace, resources, and ergonomic equipment; work/family balance concerns; increased communication difficulties; increases in work volume; and concerns around career development. In addition to being consistent with findings reported in other Canadian (9, 28) and international (29–34) surveys, these findings are in line with pre-pandemic research on telework/working from home. For instance, dissatisfaction with technology was a common concern that resulted in lost work time and frustration (34, 77). In the current study, respondents' dissatisfaction with technology was accompanied by reports that their work required much more time and effort and thereby negatively affected their productivity. Pre-pandemic research also demonstrated ergonomic challenges among workers transitioning to a telework/work from home environment, which contributed to poor posture, neck pain, sore eyes, fatigue, work-oriented discomfort, and increased employee expenses (34, 78). Individuals reported similar issues in the current study, which most likely resulted from the fact that most were unprepared for working from home and did not have adequate space or equipment at their disposal to create an ergonomic home work environment. These reported difficulties are likely to increase job strain (78), and result in other mental health concerns (79–82) if left unaddressed.

Other work-related issues, including higher workloads and concerns with career progression, may have been more unique to the current pandemic. Greater workload may have resulted from an increase in specific duties related to the pandemic, difficulty accomplishing one's work in light of inadequate technology or equipment, or even from employees' personal sense of duty to allocate time that was previously dedicated to commuting toward their work (30, 40). Increasing workloads have been found

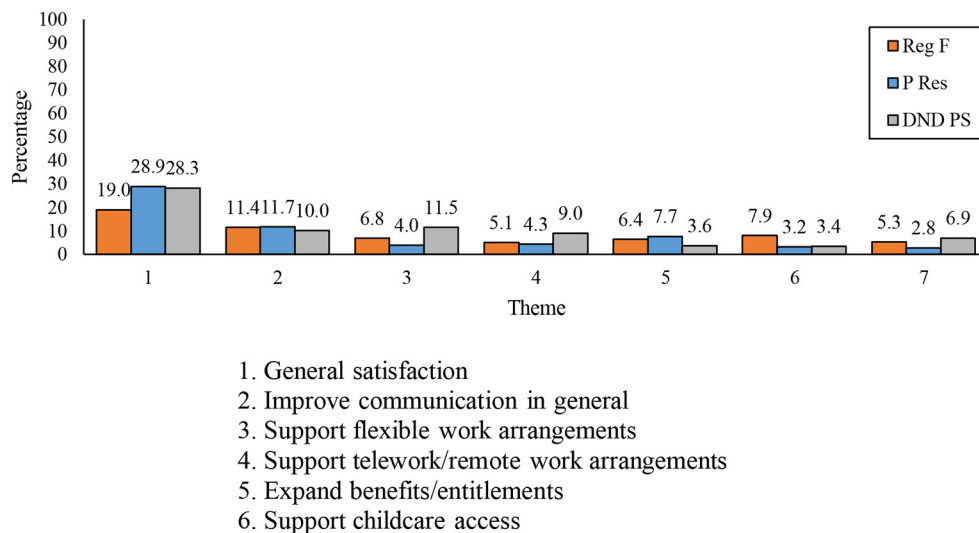


FIGURE 10 | Seven most frequently mentioned themes relating to how the DND/CAF can better support personal and family needs during the COVID-19 pandemic, by component.

to overwhelm personnel and exacerbate feelings of loneliness, emotional exhaustion, and the frequency of miscommunication within the organization (83).

While military personnel in the CAF had previously noted concerns related to their career progression (84), our results suggest that these concerns may have been exacerbated by telework in the context of the pandemic. In particular, Reg F and P Res respondents reported that the pandemic fostered uncertainty around obtaining training and education required for their career and a lack of clarity about their development and career progression. Past research has shown that perceived barriers or plateau in career progression can lead to a reduced job satisfaction, negative affect and feelings of injustice from workers directed toward the organization's leaders, a lack of work motivation, and dissociation between the organization's and the worker's goals and values (85–89).

Finally, many respondents highlighted communication challenges in the context of the current pandemic. Past CAF research has demonstrated that both the quality and quantity of information received from leaders is correlated with job satisfaction and commitment to the organization (90). Work-related organizational communication has also been shown to impact retention in both military (84, 91) and civilian organizations (92, 93). Moreover, dissemination of conflicting information from multiple sources can be particularly dangerous when considering the risks of COVID-19. Such messaging can be overwhelming for members and lead to disregarding important information about prevention. Indeed, information overload has been found to be associated with an increased fear of contracting COVID-19, as well as less vigilance regarding the dangers of COVID-19 (i.e., lower likelihood of self-isolating or physical distancing) and increased sharing of misinformation about the virus (94–96). Clear, accurate, timely, and streamlined communication is critical to provide personnel with information

on how to better prepare and protect themselves during the pandemic, and to provide them with key updates about organizational changes or directives and relevant programs, services, and other resources designed to support them.

Personal Challenges

Personnel also reported a range of personal challenges. Work-life balance concerns (also reported as a work-related challenge in the present study), may have resulted from several factors, such as a high workload and a lack of separation between home and work life (84, 97). Respondents also reported other personal challenges that may have contributed to dissatisfaction with one's work-life balance, including increased parenting demands due to loss of access to childcare, limited childcare resources and support, and school closures. Another main personal concern stemming from the pandemic was worry and stress related to the well-being of family members, especially those particularly vulnerable to the COVID-19 virus. As a result, personal time was often dominated by caring for family at the expense of time previously available for leisure, relaxation, and/or entertainment (98). Work-life imbalance can have a substantial impact not only on individuals' well-being, but also on personnel retention. For instance, retention surveys of military personnel in the CAF, the Australian Defence Force, and the New Zealand Defence Force have demonstrated that 40–50% of members reported dissatisfaction with work-life balance, which was a key element in decisions to leave the military (84, 97).

Personnel also reported that their mental health has suffered as a result of the pandemic, which is consistent with studies on the mental health outcomes of the pandemic among civilians in Canada (41, 45–47) and abroad (42, 43), and among military personnel (15, 64). Respondents in this study reported feeling anxiety, burnout, and depression due to balancing the increasing demands of their home and work lives; loneliness and sadness

due to social isolation; and anxiety and emotional exhaustion regarding the dangers of the COVID-19 pandemic and its future outcomes. Research has identified a wide variety of strategies used by individuals to cope with these mental health challenges, including maintaining a positive outlook, remaining busy, connecting to one's religion, communicating with others, and physical activity (99, 100). In the current study, personnel reported using a wide range of coping strategies, including physical exercise, meditation and mindfulness, spending time and communicating with family, and keeping busy with household projects. Indeed, these may be effective coping strategies to help ameliorate the impact of the COVID-19 pandemic, as the adoption of such strategies has been associated with reductions in anxiety and depression and better mental health outcomes in other research (100–102).

Some personnel reported arguably negative coping approaches, such as increased use of cannabis, nicotine, and alcohol. Indeed, research shows that some individuals have been struggling to adopt effective strategies to cope with stress in the face of the COVID-19 pandemic (99). It would be beneficial for the organization to offer resources and training related to effective coping in order to support the health and well-being of its members as the pandemic evolves.

Distinctions Between Components of Personnel

Given that the pandemic may affect different groups of personnel differently, its impacts on three broad groups of personnel in the DND/CAF, including Reg F, P Res, and DND PS personnel, were compared. Overall, members from the three broad groups shared similar concerns, though there were a few noteworthy differences. Specifically, DND PS personnel were more likely to report technological and ergonomic issues relative to Reg F and P Res personnel. This finding is understandable, given that DND PS members were more likely to be working from home relative to Reg F and P Res members (15). On the other hand, P Res personnel were the most likely to voice concerns regarding communication. This is not entirely surprising given that insufficient communication has been a long-standing issue for Canadian reservists (66, 103). Such challenges may be connected to the fact that reservists often have infrequent access to the departmental network and, consequently, fewer opportunities to interact with their military chain of command. This may especially hold true for reservists who are employed in civilian positions outside of the CAF.

Although differences in concerns of personnel across DND/CAF components were minimal, other research has demonstrated that not all individuals, or groups of individuals, have been impacted in the same way or to the same extent by the pandemic. Although such differences were not explored in these analyses, other research in the DND/CAF has shown that women, younger personnel, and personnel with dependent children were most likely to be negatively affected by the COVID-19 pandemic (15, 74, 104). As such, it has been recommended that factors related to the unique challenges of Defence Team members continue to be applied in the

development of organizational practices, policies, and programs (15). Moreover, given the suggestions for increased work-related flexibility made by respondents in this study, it is also suggested that supervisors and managers continue to monitor the needs and well-being of personnel and make allowances for employees' individual preferences and circumstances.

Recommendations

In addition to identifying the main challenges they have faced, respondents were given the opportunity to make recommendations on how the DND/CAF might best support its personnel. One common recommendation was to improve and streamline communication regarding COVID-19, organizational responses to the pandemic, availability of support and services, and issues concerning career progression. To this end, Ivey et al. (105) recommended developing and implementing a consolidated and centralized location for communication that includes all relevant information in an accessible manner. Similarly, Sillins and Lee (106) emphasized the importance of communicating the threat of COVID-19 clearly in order to mitigate the risk of misinformation. Furthermore, Frank et al. (107) emphasized the importance of communicating information on the implications of the pandemic on career progression and job security. On the other hand, Mattke et al. (108) suggested that communication of support and services hosted by the organization should be made available through multiple and novel channels, rather than a single channel so that information may spread from multiple channels for maximum uptake. To ensure clarity and maximum update of communications, it is important that the organization ensure that communication be delivered through multiple accessible platforms and that the information delivered is consistent across platforms.

Another recommendation was related to the provision of technological support and training to better enable personnel to work from home. In addition to this, Ivey et al. (105) recommended to limit the number of new forms of technology to only those that are absolutely necessary, and ensure that these new systems are as user friendly as possible, particularly as employees adjust to teleworking.

Other recommendations made by respondents related to the need for managers to be understanding and express empathy for employees' needs, and to offer greater flexibility to accommodate those needs. This included recognizing a reduced work capacity and accommodating individual needs and circumstances. Similar recommendations were made in a variety of studies, including the suggestion that supervisors recognize parenting stressors and new roles at home and in the workplace (109) and inform personnel of childcare support services to help with individual circumstances (110, 111). Empathy on the behalf of supervisors and manager has been associated with reductions in employee somatic complaints and increased productivity (112), and has been found to mitigate the impact of difficult circumstances (e.g., wage cuts) on employee well-being (113).

One important consideration in this regard is to maximize to the degree possible employees' choices with respect to the return to their usual place of work. By allowing subordinates to decide to work in the location that best suits them, managers

express an understanding and accommodation for individual situations, as well as confidence in their employees' abilities to work remotely. Moreover, the ability for employees to flexibly select their location for work, otherwise known as "work-from-anywhere" arrangements, can be advantageous to employee productivity (114).

Finally, while it was not specifically mentioned by personnel in the current study, research has highlighted the importance of the organization to promote physical fitness (115), for example, by encouraging personnel to use existing online support for indoor exercise programs (116). In the current study, less than half of participants reported engaging in physical exercise as a stress-management strategy. Encouraging physical exercise would aid in coping with the evolving situation of the COVID-19 pandemic and discourage sedentary behavior, which itself has been associated with anxiety, depression (81, 117, 118). A systematic review by Bentlage et al. (119) substantiated recommendations that individuals and their work teams organize comprehensive and feasible routine physical activity programs paired with digital technologies, virtual fitness programs, and relaxation protocols (i.e., indoor gardening, Tai Chi).

Strengths and Limitations

The current study had a variety of strengths, including a very large sample size and inclusion of both close- and open-ended questions to further our understanding of the challenges and needs of employees during the COVID-19 pandemic. By asking respondents to describe their main challenges and thoughts on how the DND/CAF might address these challenges in their own words, we obtained individualized information on their needs and preferences, in addition to how they believe the organization can assist in this regard. The use of open-ended questions complemented results of quantitative analyses (15) and enabled participants to express their views in the context of their unique lived experiences.

Nevertheless, some study limitations must be acknowledged. First, because of the lack of probability-based sampling, the data is subject to self-selection bias to the degree that those who responded differed from non-respondents. In addition, because the open-ended questions were presented following close-ended survey questions, the content of close-ended questions may have drawn respondents' attention specifically toward similar, or parallel, elements of their personal experiences.

Future Directions

As the situation with the COVID-19 pandemic is unprecedented and continues to evolve, the current findings raise novel directions for research on personnel well-being during the global pandemic. First, the survey was administered and collected in the early days of the pandemic, and many aspects of life and work may have changed since the start of the pandemic. Continued research is required to assess how challenges and concerns have changed since the summer of 2020. Moreover, senior members, including leaders and managers of the DND/CAF, are planning return-to-work arrangements for their subordinates. Therefore, research is required to determine and address the primary concerns military and civilian personnel have in regards to their return to their usual work locations.

Although only relatively minor differences were observed in the concerns of personnel from the three DND/CAF components, further research should investigate differences in individuals' lived experiences related to the COVID-19 pandemic along other characteristics (e.g., demographic characteristics, personality traits). Previous research has highlighted differences in concerns based on gender and family status (15). Gender differences in mental health have also been observed during the pandemic, such that women experienced greater levels of stress, anxiety and depression compared to men, and the degree of related functional impairment further varied according to individuals' family status (104).

CONCLUSION

The current study reported aggregated responses from open-ended questions highlighting challenges to military and civilian defense personnel's work and well-being amid the COVID-19 pandemic. Responses to these open-ended questions highlighted important challenges to employees' productivity and overall well-being. Moreover, some of the challenges noted in the current study affected the well-being of regular force members, reservists, and civilians in public service to different extents, highlighting the importance of considering employees' roles and unique needs. Many of the reported challenges were not only similar to civilians in other sectors who have adapted to the COVID-19 pandemic, but were also consistent with other research on telework. Supporting personnel during this stressful time is essential to employee well-being, productivity, and overall organizational effectiveness.

DATA AVAILABILITY STATEMENT

The dataset presented in this article are not readily available because the data was collected solely for the purposes and may not be shared externally or used for other purposes as per the informed consent used for this study. In addition, the data are property of her Majesty The Queen, Department of National Defense and the Government of Canada and Department of National Defense Canada: <http://forces.gc.ca/>.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Social Science Research Review Board, managed by the Director General Military Personnel Research and Analysis in the Department of National Defense. The patients/participants provided informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

IG contributed to the conception and administration of the COVID-19 Defence Team Survey, the analysis of qualitative responses, and the writing and editing of the manuscript. WD contributed to the writing and editing of the manuscript and the creation and formatting of the

tables. JL contributed to the conception administration of the COVID-19 Defence Team Survey, the analysis of qualitative responses, and editing of the manuscript. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpubh.2021.789912/full#supplementary-material>

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Comparison of Students' Mental Wellbeing, Anxiety, Depression, and Quality of Life During COVID-19's Full and Partial (Smart) Lockdowns: A Follow-Up Study at a 5-Month Interval

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Abbas J (2022) Comparison of
Students' Mental Wellbeing, Anxiety,
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Objective: Scholars have debated the COVID-19's full and partial lockdowns' effectivity to control the transmission of the new case. They emphasized the provision of required economic and social resources worldwide. Past literature related to COVID-19 has contributed little evidence to examine the efficacy of full and partial lockdown measures with experimental perspectives at different intervals. This study bridges this literature gap and explores the full and smart lockdowns' impacts on Pakistani students' mental health, depression, quality of life, and anxiety symptoms, during the various waves of the COVID-19 pandemic.

Method: This pretest and posttest experimental designed web-based survey recruited 40 students from March 23 to August 23, 2020, and recorded their responses. The study incorporated four standardized psychological instruments to receive the desired datasets related to students' mental health, quality of life, anxiety, and depression. Researchers shared data links with the participants via social media, WhatsApp. The study applied one-way and multivariate ANOVA tests (analysis of variance) to draw the desired results.

Results: This study's findings suggest that both full and partial COVID-19 lockdowns effectively improve students' mental health and quality of life. These measures help reduce anxiety and depressive symptoms among university students. The study results exhibit that partial lockdown (PL) is more effective in improving quality of life. Besides, PL helps reduce anxiety symptoms than complete lockdown among Pakistani students.

Conclusion: The present study's findings suggest that students are vulnerable. They need particular interventions and preventive measures to protect and improve their mental health and quality of life during a global pandemic. As the stressful experience of the epidemic persists in Pakistan. It will also be interesting to examine the psychological impact of the successive waves of the COVID-19 pandemic.

Keywords: mental health, anxiety, depression, quality of life, COVID-19 full lockdown, smart lockdown, COVID-19 preventive health behavior

INTRODUCTION

The epidemic of coronavirus infections (COVID-19) has been extensively affecting the living and life of individuals globally, more specifically after the statement of an international epidemic through the World Health Organization (WHO) in the month of March 2020 (1–5). There were approximately 6.91 million people infected with the COVID-19 in June 7, 2020 across the world (6, 7). Therefore, several countries of the world, such as United Kingdom, United States of America, France, Russia, India, and Pakistan, executed a variate of anti-epidemic tools, including the shutdown of private and public places, closing down the complete transit system, and limiting travel for overseas nationals to prevent the transmission of the extremely transmissible virus from people-to-people (6–14).

Pakistan confirmed its first coronavirus disease (COVID-19) case on February 26, 2020. Pakistan, like several other nations, implemented the full lockdown plan into effect on March 23, 2020, to ensure “social distance” by “home quarantine” to prevent the transmission of the extremely contagious virus in its populace (15–20). Conversely, all public and private schools were shut down first from March 23 to April 15, 2020 all over the country. However, given the complex economic situation of the country, the government converted the complete lockdown into “partial lockdown” on May 9, 2020 (15). After rigorous evaluation of the critical situation of COVID-19 in Pakistan, partial lockdown was extended to May 31, 2020, and later prolonged to August 15, 2020 in the first wave of the COVID-19 epidemic (18, 21–24), but it was finally ended on September 15, 2020 (21).

This exceptional experience of home-based quarantine during full and partial lockdown with the uncertainty of professional and academic career has complicated effects on the psychological wellbeing of university students (3, 4). For instance, a similar research conducted to explore the influence of home-based quarantine later on the serious acute respiratory syndrome epidemic established a relationship between prolonged time of home-based quarantine with a greater level of depression and anxiety in students (1–4, 18, 25).

The current epidemic of COVID-19 is developing a psychosocial chaotic condition in Pakistan like many other countries that have been experiencing a rapid increase in psychological disorders such as fear, sleep, stress, depression, anxiety disorder, substance use, and suicidal behavior in people (26–37). The results of many previous studies conducted in China revealed that the higher the disclosure of “misinformation” by social media, the more probability it is in contributing to the growth of depression, anxiety, and other psychological problems in students (14, 38, 39). Many similar studies also revealed that there is a significant reduction in daily social interactions of university students, and they experienced lack of social support due to lockdown. These, along with the occurring stressors related with the current pandemic, can all potentially lead to affect the mental health of students negatively. Earlier studies indicated that similar situations have multiple psychological consequences on the lives of students such as chronic and acute stress, depression (33, 40–44), and reduced quality of life (45–50). A similar study conducted in Chinese students indicated that

having an infected relative or acquaintance to COVID-19 is also a potential risk factor for anxiety (51). Whereas, factors, such as stable family income, living in urban area, and living with family, serve as protective factors (51).

In another survey conducted on 8,079 Chinese students with age ranging from 12 to 18 by Zhou et al. (52) stated that there was a significant prevalence of anxiety (37%), depression (43%), and combined symptoms of anxiety and depression (31%) in university students during the first wave of the COVID-19 epidemic (52, 53). A study of similar nature, also recently conducted in Pakistan by Salman et al. (54), revealed that there was positive association among COVID-19 epidemic, anxiety, and depression in university students. Furthermore, the results of this study indicated that university students were found to have moderate to severe anxiety (34%) and depression (45%) during the COVID-19 lockdown (54). Additionally, similar studies demonstrated that there was a negative impact of COVID-19 on mental health, and it also led toward anxiety and depression (9, 55–57). Other pieces of evidence also illustrated that female university students who had poor sleep quality, showed more mental health problems during the COVID-19 lockdown (58–60).

Given the bewildering situations, it is very important to examine and comprehend the psychological experience of students in Pakistan, more specifically in the COVID-19 epidemic. This kind of study is expected to explore the mental health effects of an unpredicted emergency on university students, and to create and implement effective preventions and interventions to mitigate the psychological problems of people. The present research was intended to address and comprehend the mental health problems in Pakistani university students. This study aimed to examine and compare the effect of the full and partial (smart) COVID-19 lockdown experience on mental health, quality of life, symptoms of anxiety, and depression in Pakistani university students during the first wave of the COVID-19 epidemic.

University students have also been extensively affected during the first wave of the COVID-19 epidemic. Most of the universities of the world have been shut down, and university pupils have had to experience drastic changes in their academic and social life (7). More specifically, Italian students have been the first to experience the full lockdown with the closing of educational institutes and the shift to distance education, whereas many other countries' university students were possibly already updated regarding the full and partial lockdown experience. In Pakistan, all educational institutes were first shut down on March 23, 2020, and educational activities including administrative management, degrees, lessons, and exams, have been modified to online sources. The aforementioned activities were taking face-to-face classes through online modalities, using different learning sources, and sharing class notes, such as slides and learning materials (1–4, 61), thus, university students have had to adapt and modify their learning techniques to distance classes (62–65). Furthermore, many of the university students who joined the online classes from outside their homes were forced to go back to their houses abruptly and to spend the full lockdown in their university towns.

So far, there is a few studies conducted that have explored how severe the impact of COVID-19 related lockdown is on the overall mental health and quality of life of the student population (66). The few studies that have inspected the psychological effects of COVID-19 is on the infected population (59, 60, 67, 68). Similarly, a few studies have tried to assess the impact of lockdown itself on student population and changes from pre- to post-outbreak (56). However, no study has seen the effect in Pakistani population where the students experienced two different forms of lockdowns, i.e., a full lock down and a smart lockdown (69). The present study, by considering all the factors, have tried to investigate the effect of COVID-19 lockdown on psychological, mental health, quality of life, anxiety, and depression in Pakistani students in different phases of lockdown, including complete lockdown and partial lockdown. Additionally, the study also endeavors in assessing mental health, quality of life, anxiety, and depression in those students who have preexisting mental health issues.

METHODOLOGY

Research Objective and Hypotheses

Based on the aforementioned concerns, this study aimed to explore psychological experiences of university students during both the full and partial (smart) COVID-19 lockdowns in the first wave of the COVID-19 epidemic in Pakistan. Moreover, the effect of the full and partial (smart) COVID-19 lockdown experiences on mental health, quality of life, symptoms of anxiety, and depression in Pakistani university students during the first wave of the COVID-19 epidemic was also examined and compared. More specifically, our study also planned to investigate the following hypotheses that were more closely related to psychological experiences of Pakistani university students: Hypothesis 1 (H1): A higher level of anxiety and depression will be significantly higher during the full lockdown in comparison with partial lockdown in the first wave of the COVID-19 epidemic in Pakistan. Hypothesis 2 (H2): There will be significant improvement in general mental health and quality of life during partial lockdown in comparison with full lockdown in the first wave of the COVID-19 epidemic in Pakistan. Hypothesis 3 (H3): To compare the effect of lockdown on students who have preexisting different mild, moderate, severe level of anxiety and depression on the quality of life and mental health during the full and partial phases of lockdown in the first wave of the COVID-19 epidemic in Pakistan.

Sample

Forty university students with age range from 18 to 25 ($M = 21.57$, $SD = 1.05$) years were included in the online survey at the Department of Psychology, Foundation University of Islamabad, Pakistan. This online survey was performed at the last week of March during the first wave of the COVID-19 epidemic lockdown, from March 23 to August 23, 2020. The random sampling technique and pretest–posttest experimental design was applied to collect data from BS 8 class students. A 5-month within-group, pre–post–follow-up experimental design was used to examine and compare the effect of the full and partial (smart)

COVID-19 lockdown experience on mental health, quality of life, symptoms of anxiety, and depression in Pakistani university students during the first wave of the COVID-19 epidemic. A web-based survey was used to obtain information related to mental health, quality of life, anxiety, and depression using the Google Form. The link of the data was shared with BS 8 students through social media WhatsApp. Ethical approval from higher authority of Foundation University Islamabad was obtained to perform the study. Written informed consent was also obtained from all participants before starting this study.

These inclusion criteria were applied: (1) those students who were diagnosed with COVID-19, and they were guarantees at their homes during the first wave and (2) those students who attended their regular classes from different cities of Pakistan and had proper internet access to fill the forms. The following exclusion criteria were used: those students who were not diagnosed with COVID-19 and did not have access to fill the forms during the first wave were excluded from this survey. All 40 participants were requested to complete standardized psychological questionnaires in this pre–post–follow-up experimental design web-based survey.

All participants filled up an online survey questionnaire in two different phases, such as the pretesting phase (T-0), which occurred at the time when universities were suddenly closed due to epidemic, through online social media application (WhatsApp). The survey questionnaire targeted many psychological domains including anxiety, depression, general mental health, and quality of life.

After the pretesting phase (T-0), the same 40 participants were asked to fill up the same survey questionnaire for the posttesting phase (T-1), which occurred after 22 days (3 weeks) of full lock down, as the full lockdown was lifted and converted into partial (smart) lockdown after that. Last, after the pretesting phase (T-0) and posttesting phase (T-1), the same set of participants were again asked to fill up the forms (T-2) after 5 months as a follow-up, when the smart lockdown was about to end. All participants filled out an online questionnaire in two phases, including the pretest phase (T-0). The government-imposed T-0 when authorities closed universities suddenly due to the ongoing pandemic and began a complete lockdown. After the pretest phase (T-0), the same 40 participants were asked to complete the same questionnaire for the phase of posttest (T-1) after a complete lockdown of 22 days (3 weeks). After the complete lockdown was lifted, the authorities converted the full lockdown into a partial (smart) lockdown. After the pretest phase (T-0) and the posttest phase (T-1), the same 40 participants were asked to fill out the form (T-2) again 5 months later as a follow-up when the smart lockdown was about to end.

Lockdown Phase's Detail

The COVID-19 pandemic lockdown occurred in Pakistan in two distinct phases, a complete lockdown, and a partial lockdown. The phases established in the study are based on these lockdown transitions. The first phase, T-0, came into effect on March 23, 2020, when authorities imposed a full lockdown across the country. Phase T-1 took place on April 15, 2020, when the Pakistani government eased lockdown conditions due to severe

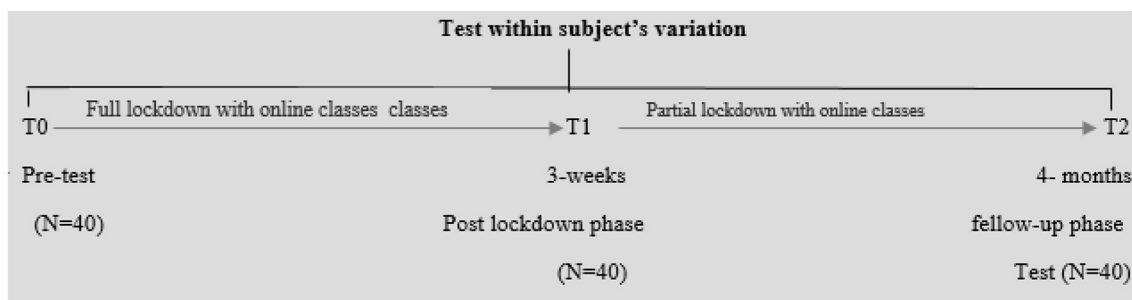


FIGURE 1 | Within group, pretest–posttest design, quasi-experimental research for both full and partial lockdown situations.

economic losses. However, given the country's complex financial situation and the rapid increase in infections, the government transitioned from a complete lockdown to a “smart lockdown” from May 9, 2020, to August 15, 2020. It was the time when the study initiated to collect data for phase T-3, as shown in **Figure 1**.

Measures

Four standardized instruments were used to measure general mental health, quality of life, depression disorder, and anxiety disorders at the different three phases during the full and partial (smart) lockdown in Pakistan students.

The Beck Depression Inventory

This instrument (Beck Depression Scale) contains 21 items, and this self-reporting tool helps measure depression severity among psychiatric individuals and healthy populations (70). The B.D.I. item scores are measured on the Likert scale of four points, ranging from 0 to 3 (0 = symptom absent and 3 = severe symptoms). The scores on the BDI-II tool are classified as follows: the B.D.I. scores within the range of 0–13 indicate normal depression, the scores between 14 and 19 show mild depression, and 20–28 scores reflect moderate depression. Similarly, the scores 29–63 show severe depression among people. Similarly, the I.P.Q. R has exemplified passable validity and reliability. The present study shows the Cronbach alphas (α) 0.91, which specifies adequate reliability.

The Beck Anxiety Inventory

The Beck Anxiety Inventory (BAI) is a self-reporting instrument that comprises the 21 items. This tool helps evaluate the anxiety severity among psychiatric people as well as a healthy population (71). The BAI instrument's each item's score is measured on the Likert scale based on four points ranging from 0 to 3 (0 = not at all and 3 = severely—it bothered me a lot). The classification of the BAI instrument is described as given: the scores 0–7 indicate low or minimal anxiety, the scores 8–15 show mild anxiety level, and the scores 16–25 indicate moderate anxiety, whereas the scores 26–63 show severe anxiety among people. The BAI measurement displayed satisfactory validity and reliability. This study has shown the Cronbach alphas (α) 0.93 that stipulates acceptable reliability.

The Warwick–Edinburgh Mental Well-Being Scale

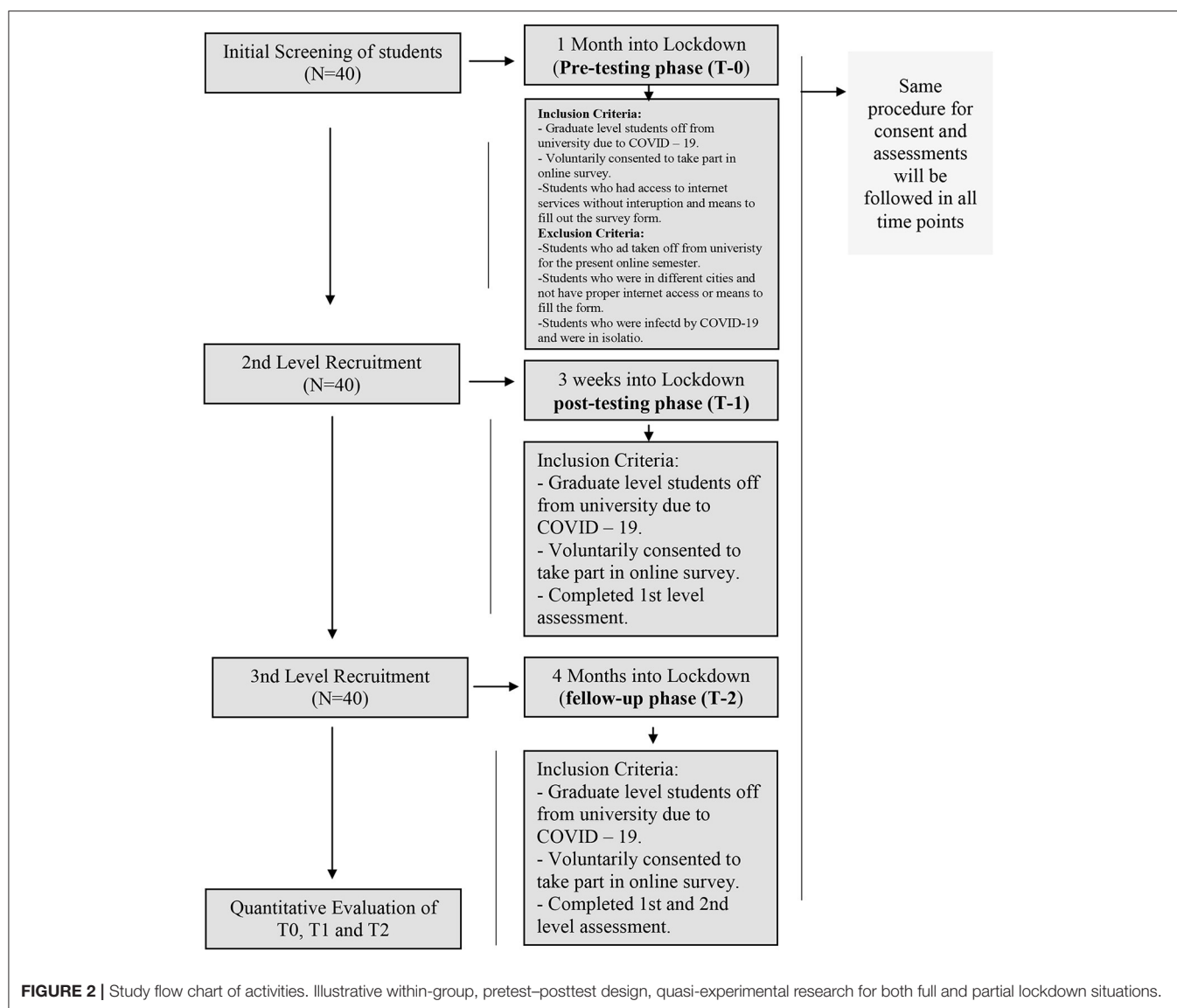
The Warwick–Edinburgh Mental Well-being scale (WEMWBS) is a self-reporting tool based on 14 items that help assess the mental wellbeing of ordinary individuals and the clinical population (72). The five-point Likert scale measures WEMWBS item scores that show the following points: 1 = none of the time and 5 = all of the time. The WEMWBS instrument indicated adequate validity and reliability. This current study has shown the Cronbach alphas (α) 0.91 that stipulates acceptable reliability.

World Health Organization Quality of Life Scale

The World Health Organization Quality of Life Scale (WHOQOL)-BREF is a self-reporting instrument that contains 26 items to measure individuals' quality of life. This tool helps evaluate normal individuals' and the clinical population's quality of life (73). The five-point Likert scale helps measure instrument items based on four subscales. It measures social relationships, environment, and psychological and physical health. The WHOQOL-BREF displayed acceptable validity/reliability. This study exhibits an adequate value of the Cronbach alpha (α = 0.94), which indicates satisfactory reliability.

Data Management and Analysis Plan

Data were collected using a web-based online survey. After completing the data, the missing values were checked using an imputation technique using SPSS-23 for all the scales used in the study. Before carrying out the analyses, values of all scales were primarily transformed into standardized Z-scores by gathering the pretest, posttest, and follow-up values from all students to compute the mean and standard deviation. One-way analysis of variance (ANOVA) and multivariate analysis were applied to analyze the data of the present study. Baseline subject comparisons have been carried out applying nonparametric statistics such as chi-square test. Moreover, multivariate analysis and chi square analysis have been performed to examine and compare the effect of the full and partial (smart) COVID-19 lockdown experience on mental health, quality of life, symptoms of anxiety, and depression in Pakistani university students during the first wave of the COVID-19 epidemic. The sample adequacy was determined by the value of eta squared (η^2) in the present



study. The value of eta squared revealed that sample size was sufficient to perform the present study (74, 75).

Procedure

This current investigation was carried out in accordance with the ethical standards of The Committee on Publication Ethics (COPE). This study was also approved by the Department of Psychology, Foundation University Islamabad, Pakistan. Forty university students living in Pakistan contributed to this pre-post-follow-up experimental design web-based survey. Four standardized psychological instruments were used to obtain information related to mental health, quality of life, anxiety, and depression using Google Forms between March 23 and August 23, 2020. Ethical approval from the higher authority of Foundation University Islamabad was obtained to perform the study. Written informed consent was also obtained from all participants before starting this study. One-way analysis of

variance (ANOVA) and multivariate analysis were applied to analyze the data of the present study.

Consort

The Consolidated Standards of Reporting Trial has been applied for reporting a pretest-posttest design, quasi-experimental research for both full and partial lockdown situations. In the current experimental study, 40 students took part in the study. All participants were enrolled at the Department of Psychology, Foundation University of Islamabad, Pakistan. The flowchart of students with demographic information is presented in Figure 2.

RESULTS

In Table 2, findings of repeated measures ANOVA demonstrated that significant differences were found only on quality of life ($F = 426.98$, $p > 0.000$) between the pretesting phase (T-0),

posttesting phase (T-1), and follow-up phase (T-2) in Pakistan students during the COVID-19 epidemic lockdown. On the contrary, no significant differences were found on mental health and development of psychological issues, such as anxiety and depression disorder between pretesting phase (T-0), posttesting phase (T-1), and follow-up phase (T-2) in Pakistan students during the COVID-19 epidemic lockdown. The time period between the pretesting phase (T-0) and posttesting phase (T-1) was assumed as full COVID-19 epidemic lockdown for students. On other hand, the same data from the posttesting phase (T-1) and follow-up phase (T-2) were considered as partial COVID-19 epidemic lockdown for Pakistan students. Findings of the study revealed that participants exposed significant improvement in the quality of life in the three phases. Moreover, eta squared (η^2) was used to examine the adequacy of effect size for the present study sample. The value of eta squared ($\eta^2 = 0.99$) shows medium effect size in the present study. The value of eta squared revealed that the sample was sufficient to perform this study (74, 75).

This study's findings demonstrated that in the first phase of lockdown in Pakistan ($T = 0$), when all the universities were closed, students reported significant decline in quality of life at the starting period of the COVID-19 epidemic, while in phase 2 ($T = 1$), when full lockdown was opened and became more lenient after 3 weeks, participants demonstrated more improvement in quality of life. On the other hand, in phase 3 ($T = 2$), when the university had their semester exams during partial lockdown, participants illustrated more slight improvement in the quality of life. The study findings indicated that full lockdown may be considered more appropriate to improve quality of life, depression disorder, and mental health compared with partial lockdown during the COVID-19 epidemic. Furthermore, findings of the study explained that full lockdown had shockingly enhanced anxiety disorders in university students, whereas in partial lockdown, although there was a slight significant improvement in quality of life, shockingly, mental health decreased, and anxiety and depression disorders both increased during the epidemic crisis.

The aim of the present study was to evaluate the impact of the COVID-19 epidemic lockdown on the interaction between level of anxiety and quality of life of Pakistan students. This study was carried out to examine the effectiveness of the COVID-19 epidemic lockdown for university students through three different phases of COVID-19 epidemic lockdown (pre, post, follow-up) in Pakistan context.

Within-subjects repeated measures ANOVA were carried out to examine the effect of the COVID-19 epidemic lockdown on anxiety, depression, quality of life, and mental health in university students based on three different phases including pre, post, and follow up (A follow-up at 5 months during the COVID-19 epidemic lockdown), in which the three phases were considered as independent variable (IV), while anxiety, quality of life, and mental health were considered as dependent variables (DVs). Results of two-way repeated measures ANOVA revealed significant differences in the three phases on quality of life, mental health, anxiety, and depression in Pakistan students during the COVID-19 epidemic lockdown. Moreover, eta squared (η^2) was used to examine the adequacy of effect size

for the present study sample. The value of eta squared ($\eta^2 = 0.99$) shows medium effect size in the present study. The value of eta squared revealed that the sample was sufficient to perform this study (74, 75).

The Effect of the COVID-19 Epidemic Lockdown on Interaction Between Anxiety Level and Quality of Life

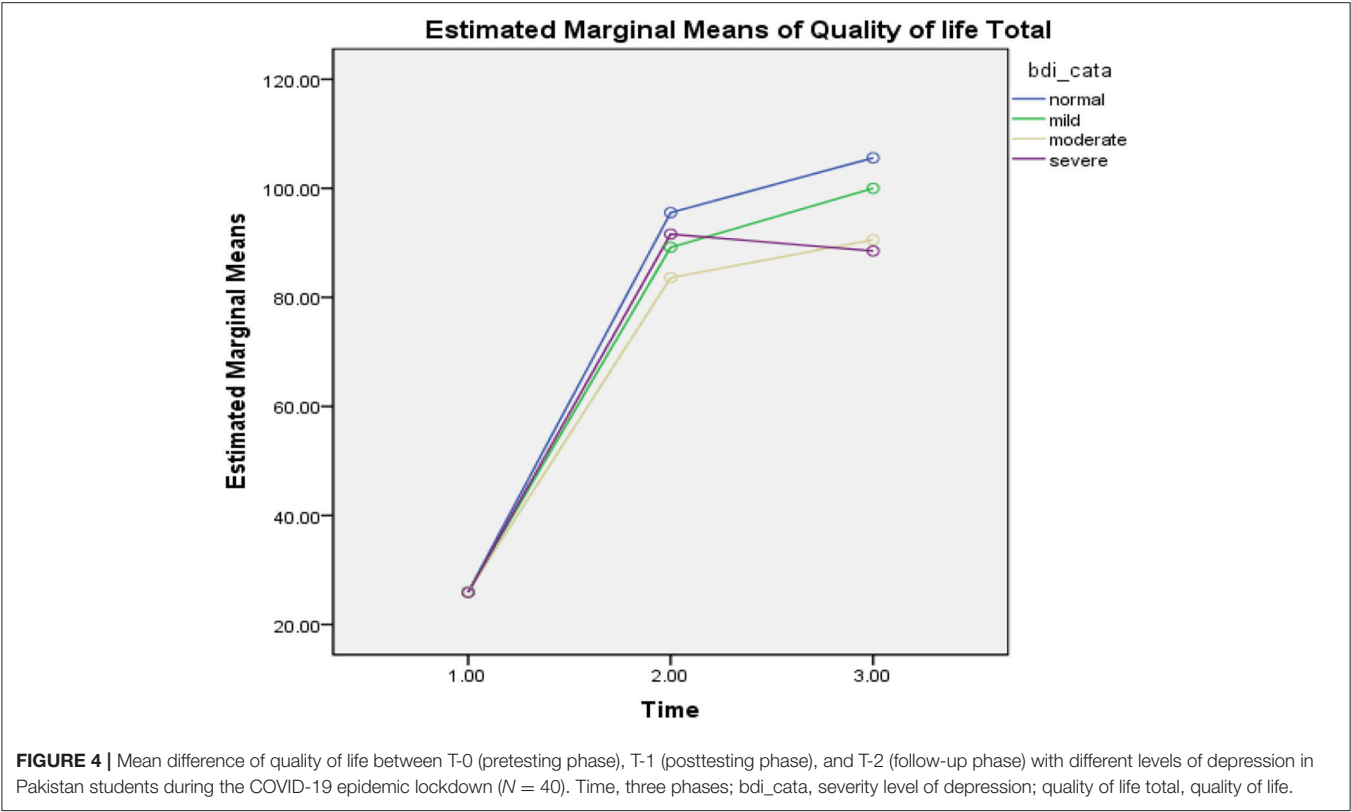
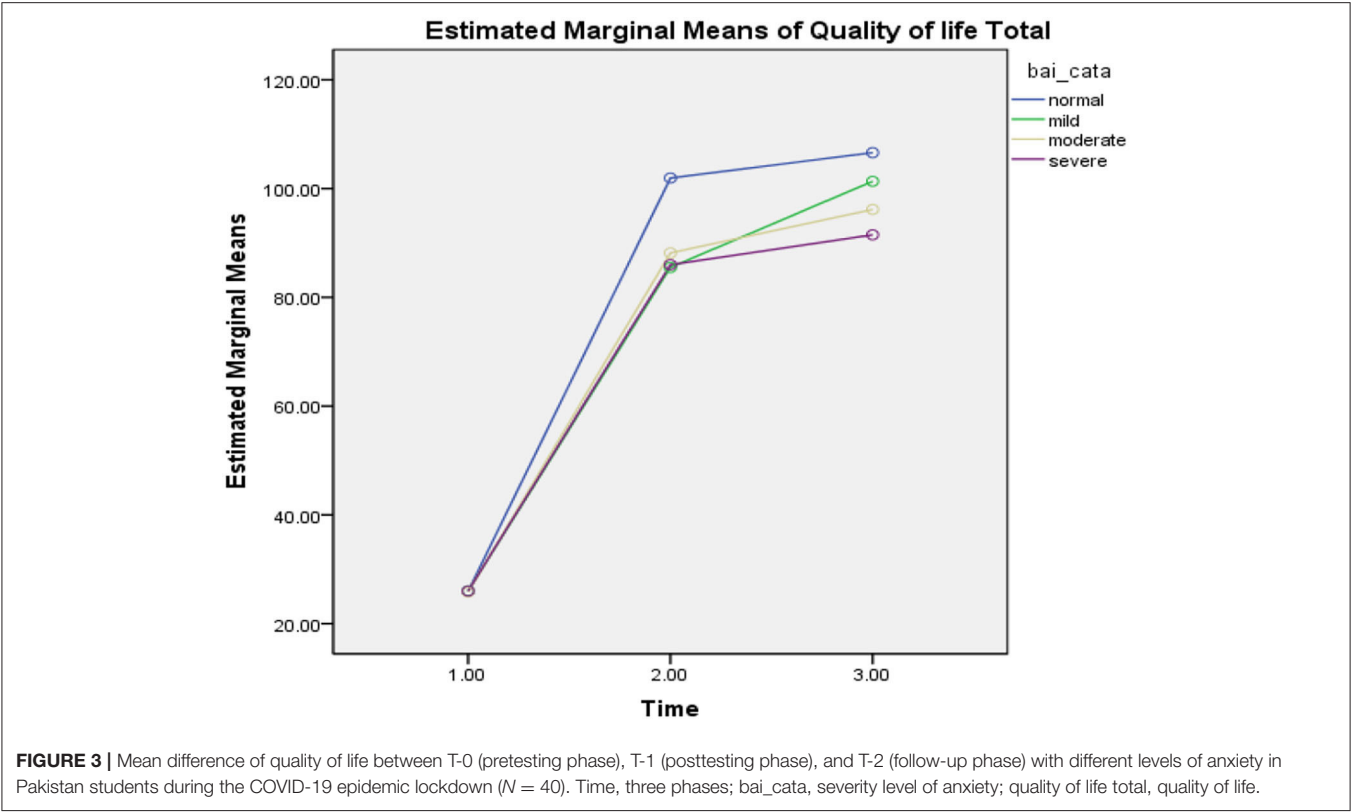
In Table 3, repeated measures ANOVA was used and displayed significant effect of the COVID-19 epidemic lockdown on the quality of life in the three phases ($F = 215.35, p = 0.000$), level of anxiety (BAI) ($F = 2.99, p = 0.12$), and interaction effect between the level of anxiety and the three phases ($F = 1.94, p = 0.08, \eta_p^2 = 1.99$). The findings of the study revealed that participants exposed significant improvement in the quality of life at the three phases (see Figure 3).

In the first phase of the lockdown in Pakistan ($T = 0$), when all universities were closed due to the COVID-19 epidemic, participants reported significant decline in quality of life with different levels of anxiety as normal ($M = 25.94, SD = 0.23, n = 18$), mild ($M = 26.00, SD = 0.02, n = 8$), moderate ($M = 25.80, SD = 0.44, n = 5$), and severe ($M = 26.00, SD = 0.01, n = 9$), while in phase 2 ($T = 1$), participants demonstrated more improvement in the quality of life with different levels of anxiety, such as normal ($M = 101.93, SD = 13.01, n = 16$), mild ($M = 85.50, SD = 24.14, n = 8$), moderate ($M = 88.16, SD = 9.70, n = 6$), and severe ($M = 86.00, SD = 13.78, n = 10$). On the other hand, in phase 3 ($T = 2$), when the university was conducting their semester exams, participants illustrated more slight improvement in the quality of life with higher level of anxiety, such as normal ($M = 106.60, SD = 10.79, n = 15$), mild ($M = 101.33, SD = 15.82, n = 9$), moderate ($M = 96.16, SD = 8.70, n = 6$), and severe ($M = 91.50, SD = 13.35, n = 10$). In the table above, the findings of the study revealed that those participants who had reported moderate and severe levels of anxiety, had lower level of quality of life compared with those who had normal and mild level of anxiety, who were also found to have a higher level of quality of life during the COVID-19 epidemic lockdown in Pakistan (see Figure 3).

The Effect of the COVID-19 Epidemic Lockdown on Interaction Between Depression Level and Quality of Life

Repeated measures ANOVA was carried out and illustrated the significant effect of the COVID-19 epidemic lockdown on the quality of life in the three phases ($F = 210.46, p = 0.000$), level of depression (BDI) ($F = 2.82, p = 0.12$), and interaction effect between level of depression and the three phases ($F = 1.21, p = 0.30, \eta_p^2 = 0.98$). The findings of the study revealed that participants had a significant improvement in the quality of life at the three phases (see Figure 4).

In the first phase of the lockdown in Pakistan ($T = 0$), when all universities were closed due to the COVID-19 epidemic, participants reported a significant decline in the quality of life with different levels of depression such as normal ($M = 25.96, SD = 0.20, n = 25$), mild ($M = 26.00, SD = 0.00, n = 4$), moderate



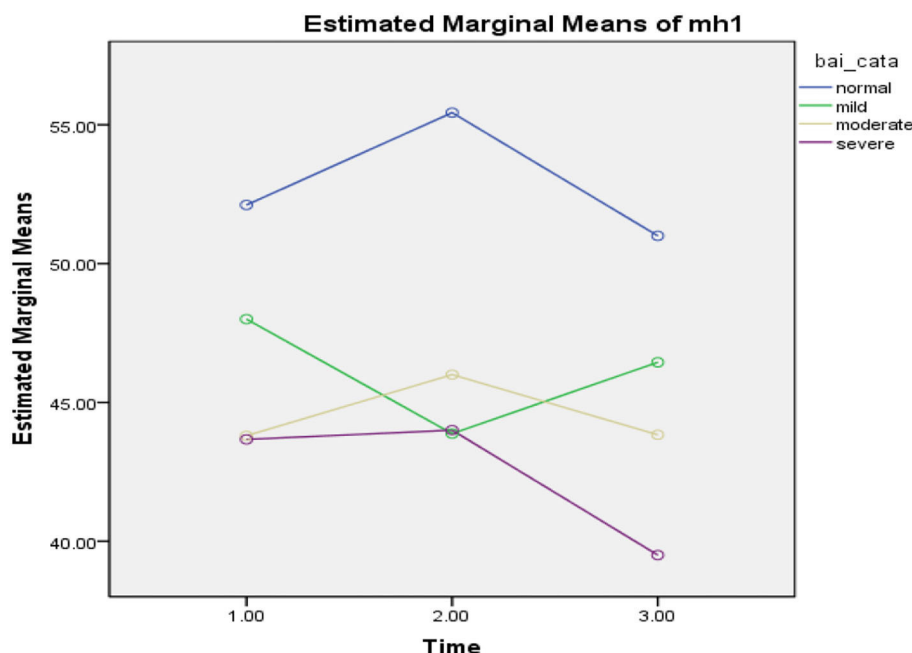


FIGURE 5 | Mean difference of mental health between T-0 (pretesting phase), T-1 (posttesting phase), and T-2 (follow-up phase) with different levels of anxiety in Pakistan students during the COVID-19 epidemic lockdown ($N = 40$). Time, three phases; bai_cata, severity level of anxiety; quality of life total, quality of life.

($M = 26.00$, $SD = 0.00$, $n = 4$), and severe ($M = 25.85$, $SD = 0.37$, $n = 7$), while in phase 2 ($T = 1$), participants demonstrated more improvement in the quality of life with different levels of depression such as normal ($M = 95.54$, $SD = 19.28$, $n = 24$), mild ($M = 89.16$, $SD = 10.98$, $n = 6$), moderate ($M = 83.60$, $SD = 5.94$, $n = 5$), and severe ($M = 91.60$, $SD = 17.05$, $n = 5$). On the other hand, in phase 3 ($T = 2$), when the university was conducting their semester exams, participants illustrated more slight improvement in quality of life with higher level of depression such as normal ($M = 105.58$, $SD = 11.38$, $n = 24$), mild ($M = 100.00$, $SD = 7.00$, $n = 3$), moderate ($M = 90.55$, $SD = 13.29$, $n = 9$), and severe ($M = 88.50$, $SD = 13.22$, $n = 4$). In the table above, the findings of the study revealed that those participants who had moderate and severe levels of depression, were reported to have a lower level of quality of life compared with those who had normal and mild level of depression, who were also found to have a higher level of quality of life during the COVID-19 epidemic lockdown in Pakistan (see **Figure 4**).

The Effect of the COVID-19 Epidemic Lockdown on Interaction Between Anxiety Level and Mental Health

Repeated measures ANOVA was applied and showed a significant effect of the COVID-19 epidemic lockdown on mental health in the three phases ($F = 1.02$, $p = 0.39$), level of anxiety (BAI) ($F = 19.81$, $p = 0.002$), and interaction effect between level of anxiety and the three phases ($F = 0.40$, $p = 0.87$, $\eta_p^2 = 0.99$). The findings of the study demonstrated that participants had a significant decline in mental health having different levels of anxiety at the three phases (see **Figure 5**).

In the first phase of the lockdown in Pakistan ($T = 0$), when all universities were closed due to the COVID-19 epidemic, the participants reported a significant decline in mental health with different levels of anxiety as normal ($M = 52.11$, $SD = 11.22$, $n = 18$), mild ($M = 48.00$, $SD = 5.83$, $n = 8$), moderate ($M = 43.80$, $SD = 8.01$, $n = 5$), and severe ($M = 43.66$, $SD = 10.94$, $n = 9$), while in phase 2 ($T = 1$), participants demonstrated more decline in mental health with the different levels of anxiety, such as normal ($M = 55.43$, $SD = 8.86$, $n = 16$), mild ($M = 43.87$, $SD = 13.62$, $n = 8$), moderate ($M = 46.00$, $SD = 7.23$, $n = 6$), and severe ($M = 44.00$, $SD = 5.49$, $n = 10$). On the other hand, in phase 3 ($T = 2$), when the university conducted their semester exams, participants illustrated more decline in mental health with higher level of anxiety such as normal ($M = 51.00$, $SD = 10.74$, $n = 15$), mild ($M = 46.44$, $SD = 13.63$, $n = 9$), moderate ($M = 43.83$, $SD = 5.56$, $n = 6$), and severe ($M = 39.50$, $SD = 7.41$, $n = 10$). In the table above, the findings of the study revealed that those participants who had reported moderate and severe level of anxiety were found to have a lower level of mental health compared with those who had normal and mild levels of anxiety, who were also found to have higher level of mental health during the COVID-19 epidemic lockdown in Pakistan (see **Figure 5**).

The Effect of the COVID-19 Epidemic Lockdown on Interaction Between Depression Level and Mental Health

Repeated measures ANOVA was applied and showed a significant effect of the COVID-19 epidemic lockdown on mental health in the three phases ($F = 1.90$, $p = 0.18$), level of depression

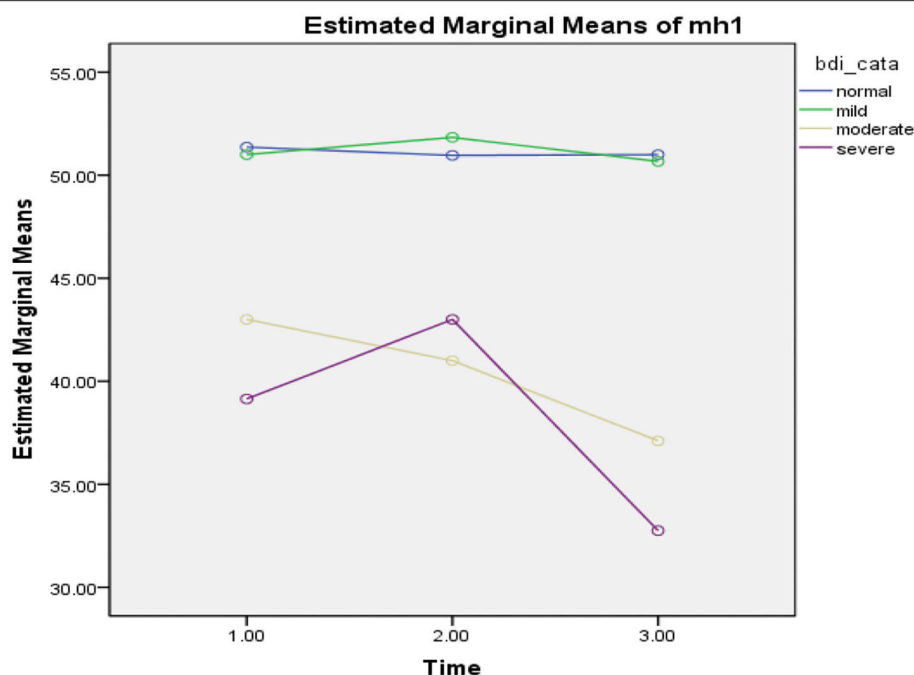


FIGURE 6 | Mean difference of mental health between T-0 (pretesting phase), T-1 (posttesting phase), and T-2 (follow-up phase) with different levels of depression in Pakistan students during COVID-19 epidemic lockdown ($N = 40$). Time, three phases; bdi_cata, severity level of depression; quality of life total, quality of life.

(BDI) ($F = 24.31$, $p = 0.000$), and interaction effect between level of anxiety and the three phases ($F = 0.49$, $p = 0.80$, $\eta_p^2 = 0.99$). The findings of the study demonstrated that participants showed a significant decline in mental health having different levels of depression at the three phases (see **Figure 6**).

In the first phase of the lockdown in Pakistan ($T = 0$)m when all universities were closed due to the COVID-19 epidemic, the participants reported a significant decline in mental health with different levels of depression as normal ($M = 51.36$, $SD = 10.44$, $n = 25$), mild ($M = 51.00$, $SD = 6.37$, $n = 4$), moderate ($M = 43.00$, $SD = 7.25$, $n = 4$), and severe ($M = 39.14$, $SD = 6.96$, $n = 7$), while in phase 2 ($T = 1$), participants demonstrated more decline in mental health with different levels of depression such as normal ($M = 50.95$, $SD = 11.81$, $n = 24$), mild ($M = 51.83$, $SD = 4.30$, $n = 6$), moderate ($M = 41.00$, $SD = 4.52$, $n = 5$), and severe ($M = 43.00$, $SD = 6.36$, $n = 5$). On the other hand, in phase 3 ($T = 2$), when the university conducted their semester exams, participants illustrated more decline in mental health with a higher level of depression such as normal ($M = 51.00$, $SD = 9.13$, $n = 24$), mild ($M = 50.66$, $SD = 2.30$, $n = 3$), moderate ($M = 37.11$, $SD = 6.19$, $n = 9$), and severe ($M = 32.75$, $SD = 9.42$, $n = 4$). In the table above, the findings of the study revealed that those participants who had reported moderate and severe level of depression, were found to have a lower level of mental health compared with those who were found with normal and mild level of depression, who were also found to have a higher level of mental health during the COVID-19 epidemic lockdown in Pakistan (see **Figure 6**).

DISCUSSION

The present research aimed to explore psychological experiences of university students during both the full and partial (smart) COVID-19 lockdowns in the first wave of the COVID-19 epidemic in Pakistan. More particularly, the effect of the full and partial (smart) COVID-19 lockdown experiences on mental health, quality of life, symptoms of anxiety, and depression in Pakistani university students during the first wave of the COVID-19 epidemic was also examined and compared. Additionally, the effect of lockdown on students who had preexisting different mild, moderate, severe levels of anxiety, and depression on the quality of life and mental health during the full and partial phases of lockdown in the first wave of the COVID-19 epidemic in Pakistan was compared. This study's findings revealed that both the full and partial COVID-19 epidemic lockdown were considered effective in improving mental health and quality of life or reducing symptoms of anxiety and depression in Pakistani university students. Furthermore, this study revealed that partial lockdown is more effective in improving the quality of life and reducing symptoms of anxiety in comparison with the full lockdown in a sample of Pakistani students. The results of the present study supported our study objectives and hypotheses. The results of the present study supported the findings of previous studies (26–39, 76). The current epidemic of COVID-19 is developing a psychosocial chaotic condition in Pakistan like many other countries that have been experiencing a rapid increase in psychological disorders such as fear, sleep, stress, depression, anxiety disorder, substance use, and suicidal behavior in people (26–37). The COVID-19

TABLE 1 | For baseline data chi square analysis between level of anxiety and depression pretesting phase (T-0), posttesting phase (T-1), and follow-up phase (T-2) in Pakistan students during COVID-19 epidemic lockdown ($N = 40$).

	Pretest				Posttest				Follow-up			
	Observed	Expected	χ^2	p -Value	Observed	Expected	χ^2	p -Value	Observed	Expected	χ^2	p -Value
Anxiety												
Normal	18	10.0	9.40	0.024	16	10.0	5.60	0.13	15	10.0	4.20	0.24
Mild	8	10.0			8	10.0			9	10.0		
Moderate	5	10.0			6	10.0			6	10.0		
Severe	9	10.0			10	10.0			10	10.0		
Depression												
Normal	25	10.0	30.60	0.000	24	10.0	26.20	0.000	24	10.0	28.20	0.000
Mild	4	10.0			6	10.0			3	10.0		
Moderate	4	10.0			5	10.0			9	10.0		
Severe	7	10.0			5	10.0			4	10.0		

TABLE 2 | Mean difference of anxiety disorder, depression, quality of life, and mental health between pretesting phase (T-0), posttesting phase (T-1), and follow-up phase (T-2) in Pakistan students during COVID-19 epidemic lockdown ($N = 40$).

Variables	Pretest phase ($n = 40$)		Posttest phase ($n = 40$)		Follow-up test phase ($n = 40$)			p	η^2
	M	SD	M	SD	M	SD	F		
Mental health	48.35	10.31	48.85	10.36	46.02	10.83	0.82	0.44	–
Anxiety	14.37	13.47	15.22	13.38	15.25	13.64	0.05	0.94	–
Depression	14.65	12.87	13.52	10.81	13.80	11.33	0.10	0.90	–
Quality of life	25.95	0.22	92.60	16.91	100.07	13.49	426.98	0.000	0.99

epidemic has been extensively affecting the life of university students, and it has not only brought severe medical related issues but also has caused a lot of mental health issues mostly due to lockdown (6–14, 17, 18, 77). Moreover, previous studies illustrated that the COVID-19 epidemic has a detrimental effect on the psychological wellbeing of people globally (11, 18, 78, 79). Most of the earlier studies revealed that the university student's population was considered one of the most vulnerable population during the first wave of the COVID-19 epidemic. University students have severe mental health problems as a result of the partial and full lockdown due to closure of educational institutes. It is considered that peer influence and interaction with teachers play an important positive role in reducing their mental health problems including stress, anxiety, and depression. It also helps them to improve mental health and quality of life in university students. Furthermore, it helps them cope with their personal issues in student life, their social networking, and interactions with teachers (16, 80). However, due to COVID-19 outbreak, many countries in the world shut down all their educational institutes. Like other countries, Pakistan was also facing a similar issue and shut down all academic institutes to prevent transmission of the contagious virus (18, 54). However, unlike other countries, the nature of the lockdown in itself was unique in Pakistan as majority of the countries opted for a full lockdown. In Pakistan, due to the economic condition, a partial lockdown was employed in the latter half (21). University students of

Pakistan also faced and reported deleterious mental health and health issues (16, 18). Many similar studies also revealed that there is a significant reduction in the daily social interactions of university students, and they experienced lack of social support due to lockdown. These, along with the occurring stressors related with the current pandemic, can all potentially lead to affect the mental health of students negatively. Earlier studies indicated that similar situations have multiple psychological consequences on the lives of students such as chronic and acute stress, depression (33, 34, 37, 39–44, 53), and reduced quality of life (45–47). A similar study conducted in Chinese students indicated that having an infected relative or acquaintance can also be a potential risk factor for anxiety (51), whereas factors like stable family income, living in an urban area, and living with family served as protective factors (51).

In **Table 1**, the results of the present study also demonstrated that university students were reported to have different levels of anxiety and depression during the full and partial lockdown in Pakistan. It revealed that partial lockdown is more effective in improving the quality of life and reducing symptoms of anxiety in comparison with full lockdown in the sample of Pakistani students. The results of the present study did not support the first hypothesis of the present study. The results showed that there was a decrease in the number of students who reported as having a normal level of anxiety in the initial phase (T-0), whereas the level of depression remained more or less constant throughout the

TABLE 3 | Mean difference of quality of life and mental health between pre-testing phase (T-0), post testing phase (T-1), and follow-up phase (T-2) with different level of anxiety and depression in Pakistan students during the COVID-19 epidemic lockdown ($N = 40$).

Level of anxiety	Pretesting phase (T-0)			Posttesting phase (T-1)			Follow-up testing phase (T-2)			BAI		Time		BAI * time		
	M	SD	N	M	SD	N	M	SD	N	F	p-value	F	p-value	F	p-value	η_p^2
Quality of life																
Normal	25.94	0.23	18	101.93	13.01	16	106.60	10.79	15	2.99	0.12	215.35	0.00	1.94	0.08	1.00
Mild	26.00	0.02	8	85.50	24.14	8	101.33	15.82	9							
Moderate	25.80	0.44	5	88.16	9.70	6	96.16	8.70	6							
Severe	26.00	0.01	9	86.00	13.78	10	91.50	13.35	10							
Mental health																
Normal	52.11	11.22	18	55.43	8.86	16	51.00	10.74	15	19.81	0.002	1.02	0.39	0.40	0.87	0.99
Mild	48.00	5.83	8	43.87	13.62	8	46.44	13.63	9							
Moderate	43.80	8.01	5	46.00	7.23	6	43.83	5.56	6							
Severe	43.66	10.94	9	44.00	5.49	10	39.50	7.41	10							

Level of depression	Pretesting phase (T-0)			Posttesting phase (T-1)			Follow-up testing phase (T-2)			BDI		Time		BDI * time		
	M	SD	N	M	SD	N	M	SD	N	F	p-value	F	p-value	F	p-value	η_p^2
Quality of life																
Normal	25.96	0.20	25	95.54	19.28	24	105.58	11.38	24	2.82	0.12	210.46	0.00	1.21	0.30	0.98
Mild	26.00	0.00	4	89.16	10.98	6	100.00	7.00	3							
Moderate	26.00	0.00	4	83.60	5.94	5	90.55	13.29	9							
Severe	25.85	0.37	7	91.60	17.05	5	88.50	13.22	4							
Mental health																
Normal	51.36	10.44	25	50.95	11.81	24	51.00	9.13	24	24.31	0.00	1.90	0.18	0.49	0.80	0.99
Mild	51.00	6.37	4	51.83	4.30	6	50.66	2.30	3							
Moderate	43.00	7.25	4	41.00	4.52	5	37.11	6.19	9							
Severe	39.14	6.96	7	43.00	6.36	5	32.75	9.42	4							

BAI, Back Anxiety Inventory; BDI, Back Depression Inventory; QOL, Quality of life; MH, Mental Health.

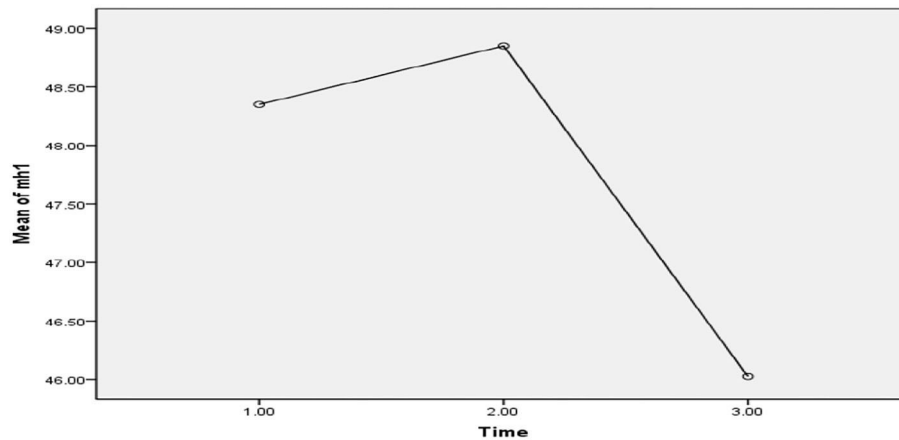


FIGURE 7 | Illustrative mean difference of mental health between the pretesting phase (T-0), posttesting phase (T-1), and follow-up phase (T-2) in Pakistan students during the COVID-19 epidemic lockdown ($N = 40$).

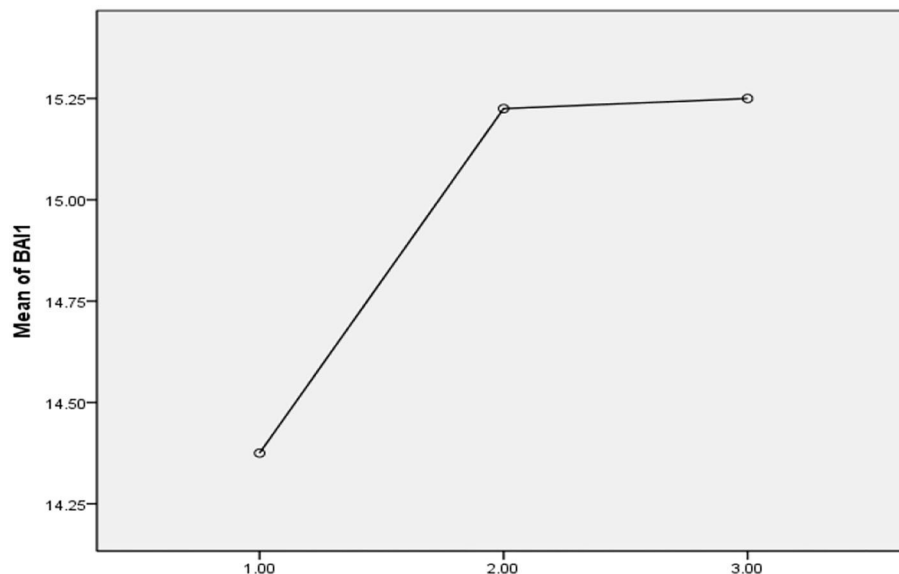


FIGURE 8 | Illustrative mean difference of anxiety disorder between the pretesting phase (T-0), posttesting phase (T-1), and follow-up phase (T-2) in Pakistan students during the COVID-19 epidemic lockdown ($N = 40$).

study. Concurrently, Hypothesis 2 of the study was also rejected as the findings in **Table 2** demonstrated that a full lockdown could be considered more appropriate to improve the quality of life, depression disorder, and mental health compared with partial lockdown during the COVID-19 epidemic (as evidenced by **Figures 1, 2, 7–10** and **Table 2**). Furthermore, findings of the study revealed that a full lockdown significantly increased anxiety disorders in university students, whereas in partial lockdown, although there was a slight significant improvement in the quality of life, nevertheless, mental health also decreased in addition to an increase in anxiety and depression disorders (see **Figures 1, 2, 7–10** and **Table 2**). The outcomes helped in achieving the

objective of the study, which was to assess and compare the effects of full and partial lockdown on mental health, quality of life, anxiety, and depression in Pakistan student population. Although partial (smart) lockdown showed lesser effectiveness than the full lockdown, this could be due the time period, and no existing research available on the comparison between the two could be a potential indication for comparison between different countries. As an increase in anxiety was consistent throughout the full and partial lockdown, it is also consistent with findings of some previous research (10, 54).

Similarly, results in **Table 3** of the study indicated that those participants who had reported preexisting moderate and severe

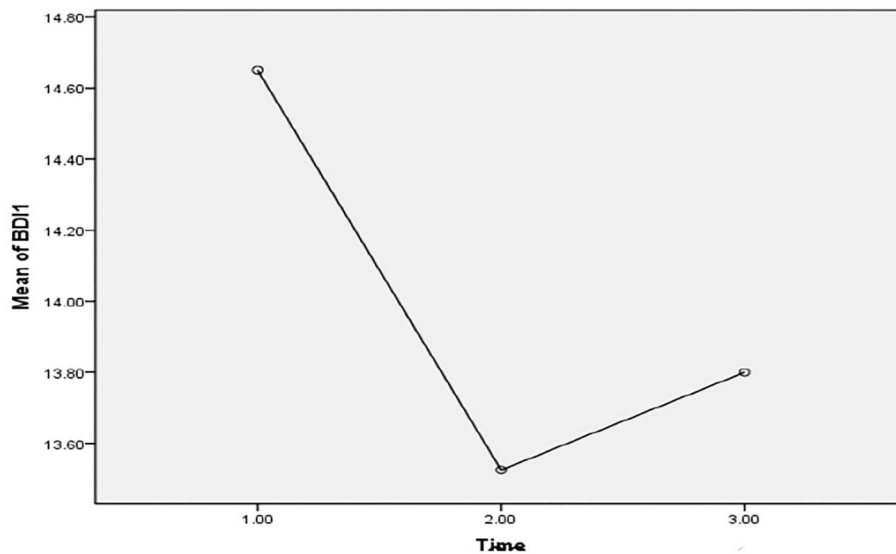


FIGURE 9 | Illustrative mean difference of depression disorder between the pretesting phase (T-0), posttesting phase (T-1), and follow-up phase (T-2) in Pakistan students during the COVID-19 Epidemic lockdown ($N = 40$).

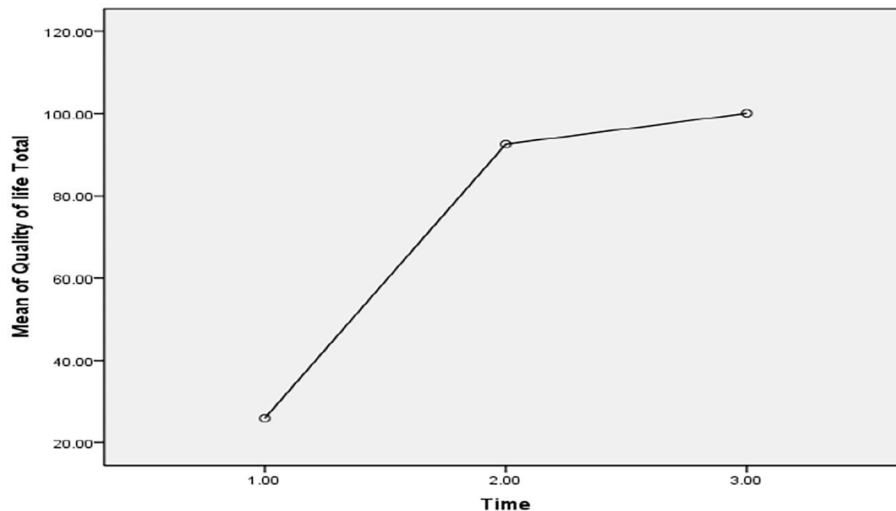


FIGURE 10 | Illustrative mean difference of quality of life between the pretesting phase (T-0), posttesting phase (T-1), and follow-up phase (T-2) in Pakistan students during the COVID-19 epidemic lockdown ($N = 40$).

levels of depression and anxiety disorders during both lockdowns showed that their mental health deteriorated in comparison with those who had reported normal and mild level of depression and anxiety disorders in both lockdown phases (See **Figures 1, 2, 7–9** and **Table 2**). Moreover, the findings of the study also indicated that all participants who reported preexisting anxiety and depression disorders during both lockdown phases had an increased quality of life. Thus, the findings facilitated in achieving the second aim of the study, which was to assess the effect of the different phases of the lockdown on students

with preexisting anxiety and depression (see **Figures 1, 2, 7–9** and **Table 2**). Both lockdown situations have their own positive or negative outcomes in humans globally. Similar in Pakistan context, full lock down appeared more beneficial and favorable to improve mental health, quality of life, and depression disorder in university students during the COVID-19 epidemic, but the prevalence of anxiety disorder was increased in university students. However, partial lockdown also improved mental health, but it reduced the quality of life as well as increased mental issues such as depression and anxiety in university students.

These findings are also in line with that of studies of similar nature conducted on student samples (58, 66, 80).

The current results clarified the present study's aforementioned objectives. They are also consistent with the findings of other studies with similar subject matter (11, 54, 58, 66, 80). Unfortunately, the few studies conducted on the effectiveness of both partial and full lockdown on mental health issues were not consistent because of either different samples or were more of a review, in general, rather than an empirical study (81, 82). However, recently many governments of different countries have been taking steps in implementing partial lockdown to handle the COVID-19 pandemic crisis such as many European countries like Germany, Rome, and Calabria (83). The results based on statistics suggest that partial lockdown may be better in controlling the spread of the virus while sustaining economic conditions (48, 59, 84–88). The findings of the present study highlight the effects of a stretched-out lockdown on a student's mental health (50, 89–93). Nevertheless, this should be further studied in a larger setting to check the effect of both full and partial lockdown on different populations in future studies on a larger sample.

Findings of the current study can help out in comprehending the eminent need of interventional strategies to cater to the mental health issues students are facing as a result of lockdown in Pakistan. No doubt, the economic outcomes are merely too large to plan a full lockdown in Pakistan, especially when majority of the people live below the poverty line. However, controlling and mitigating only the spread of the virus while ignoring the severe mental health consequences as a result are not permanent solutions, and authorities should devise strategies such as online counseling sessions or a reduced number of physical classes with odd–even number of students for them to relieve their stress and anxiety.

FUTURE IMPLICATIONS

The present study is currently one of its kind as it has tried not only to assess the effect of lockdown on psychological health of students but also has tried to incorporate the effect of both full and partial lockdown on a student's psychological health. The findings call for immediate action by policymakers to devise mental health interventions for student's mental health. Additionally, the study can also prove beneficial for authorities to design a lockdown system while taking into consideration the effects of lockdown on the mental health of student population in Pakistan.

LIMITATIONS AND SUGGESTIONS

1. The study though was effective in comparing the effect of full and partial lockdown on a student's psychological health, and the sample size was relatively small since the access was mostly

online and limited. Future studies should incorporate a larger sample to encapsulate the findings.

2. Although data were collected as soon as the lockdown was in effect, however, since the lockdown already started, the students' psychological health was already affected. It would have been better if initial data could have been collected from the time universities were still open.
3. Another limitation was the difference in timing of full and partial lockdown, which could have an effect on the overall findings since the full lockdown in Pakistan was for a shorter period, while partial lockdown was for months. It would be interesting for future studies to compare data between the countries with full lockdown for the same period with that of partial lockdown in Pakistan.

CONCLUSION

The results of the present study illustrate that university students are considered a vulnerable populace, and particular interventions and preventions are required to protect and improve their mental health and quality of life during the epidemic globally. It would also be very interesting to examine the psychological influence of the following waves of epidemic because of the persistence of the epidemic's stressful experience in Pakistan. Additionally, the findings of the present study are crucial in assessing the effect of lockdown on student's psychological mental health and quality of life. The study can be used to plan future lockdown accordingly and implementation of mental health interventions to improve mental health and quality of life of affected students and those with preexisting mental health problems. This study concluded that the COVID-19 epidemic lockdown was a more effective and preventive tool against COVID-19 to improve quality of life, mental health, and depression compared with partial lockdown in Pakistan students. Findings of this study suggested to keep full lockdown for a shorter period of time in a vulnerable university to tackle the COVID-19 crisis. This current article proposes a preventive model that helps reduce students' mental health and quality of life challenges amid partial and complete lockdowns of the COVID-19 pandemic. Illness perception develops into individuals' mental disorders, such as psychological disorders, depression, and anxiety problems, that can reduce an individual's mental health. Ultimately, it influences an individuals' quality of life. As a result, there is a need for crucial preventive measures for the ongoing pandemic to conduct clinical investigations to address depression, anxiety, and mental disorders. This study's findings offer helpful insights and recommend practical steps to evaluate the individuals' mental health issues caused by the present pandemic. The managerial and clinical preventive strategies suggest clinical examinations to combat this lethal pandemic worldwide. The study results recommend that health professionals formulate a preventative strategy to educate people to follow preventive

measures. The findings suggest promoting safety education and healthcare facilities amid the COVID-19's wide-ranging crisis. The study outcomes climax the vital preventive strategies to deal with the mental health challenges in this current pandemic.

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.

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ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Foundation University of Islamabad. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Family Functioning and Optimism as Protective Factors of Life Satisfaction Among Stroke Patients During the COVID-19 Epidemic in Shenyang, China

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The coronavirus disease-19 (COVID-19) pandemic may result in detrimental consequences for stroke patient's wellbeing. Family functioning and optimism could help stroke patients cope with crises leading to possible improvements in life satisfaction. This study aims to explore the protective effects of family functioning and optimism on life satisfaction among stroke patients during the COVID-19 pandemic in China. This study was designed as a cross-sectional survey. A total of 207 stroke inpatients who were receiving pharmacotherapy and rehabilitation in general public hospital of Liaoning province during the COVID-19 pandemic in China were consecutive selected and interviewed by online questionnaires via the WeChat platform effectively from April 8 to 30, 2020. The scales included: Satisfaction with Life Scale (SWLS), Family Adaptation, Partnership, Growth, Affection, and Resolve (APGAR) Scale and Revised Life Orientation Test (LOT-R). Hierarchical multiple regression (HMR) analysis was conducted to test the associated factors of life satisfaction. Stroke patient's life satisfaction was at a high level (Mean = 26.46, SD = 6.23) during the pandemic. Stroke patient's residence, duration of stroke, stroke type, and community shut down measures were the strong predictors of life satisfaction. Family functioning and optimism increased life satisfaction among stroke patients. This study contributes to the research on the association between family functioning and optimism on life satisfaction among stroke patients during the COVID-19 pandemic. Interventions that improve family functioning and enhance optimism should be provided in order to elevate life satisfaction for stroke patients.

Keywords: COVID-19, life satisfaction, family functioning, optimism, stroke patients

INTRODUCTION

With the surge of people infected with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) the virus that causes coronavirus disease 2019 (COVID-19) and the stringent implementation of public health restrictions (e.g., traffic restrictions, home quarantine, and physical distancing legislation) have broadened the impact of the pandemic to a point where it will affect life satisfaction for all members of society, especially for patients with cerebrovascular disease (1–4). Stroke as the most common cerebrovascular disease in adults and is highly correlated with physical disability that may require long-term treatment and rehabilitation, which may severely affect the life satisfaction of patients (5).

According to China Stroke Statistics 2019 by Wang, nearly 110,000 patients suffer from strokes every year, accounting for a total of 30,000 deaths and 500,000 stroke related disabilities annually (6). The experience of a stroke brings a heavy burden financially, mentally, and physically to detrimentally affected patients and their family members (7). Life satisfaction is the multidimensional measurement of subjective wellbeing. In order to measure life satisfaction, one must reflect on their overall health, interpersonal relationships, socioeconomic status, ability in self-care, and leisure activities (8–10). Thus, life satisfaction was used as a measure to investigate to what extent the epidemic response, family functioning, and optimism have impacted stroke patients during the COVID-19 epidemic.

The COVID-19 pandemic has brought about new social environments characterized by curfews and physical distancing, which could affect health care services and treatment procedures, resulting in the reduction of life satisfaction (11). The uncertainty and anxiety surrounding the COVID-19 pandemic has caused psychological distress for stroke patients who are under clinical treatment in hospitals, which may negatively affect their subjective health, life satisfaction, and overall wellbeing (12). Data from Vestling et al. (13) showed that, compared to stroke patients without distress or fear regarding the COVID-19 pandemic, patients with moderate or high levels of distress or fear could have a lower level of global satisfaction, which could be particularly problematic among stroke patients. Stroke patients with low access to health care may be especially vulnerable during the COVID-19 pandemic and have an increased risk for poor subjective wellbeing and psychological health (14). In particular, the COVID-19 pandemic has the potential to produce a vast array of psychological health challenges such as adjustment disorder, fear, and anxiety, which may negatively impact the life satisfaction of stroke patients (15, 16). Further, stroke patients who are suffering from greater impairments, including extensive reductions in daily activities, have poorer life satisfaction, compared with the general population under the COVID-19 pandemic (17). Studies have found that the clinical visit rate of stroke

disease decreased sharply during the COVID-19 pandemic, which could lead to reduced life satisfaction for chronic patients (18).

In China, caring for stroke patients is expected to be done by family members who are considered the major source of financial, material and psychological support (19). A great number of studies have examined the effect of family functioning on stroke patient's life satisfaction. Olson Circumplex model is a theoretical framework that pays attention to interpret family balance relationship and individual wellbeing, according to the Olson Circumplex model, balanced family characterized without too little interaction or too much consensus within the family can positively influence individual's wellbeing and life satisfaction (20). Family functioning is defined by the relationships and roles within a family that contribute to problem management, adjustment to new family practices, and effective communication (21, 22). A study conducted by Koutra et al. (23) explored the role of family support in patients with chronic diseases, which revealed that patients with adequate supportive families tend to report lower emotional distress, which could improve their subjective wellbeing.

Based on the Broaden-and-Build Theory, positive emotions promote the individual's adaptation to the society by establishing lasting personal resources, such as social and psychological resources, which could finally predict their judgments of subjective wellbeing (24). Positive psychological resources may help stroke patients adapt to changing demands and improve emotional stability when confronted with mental disorders, which could enhance life satisfaction (25). Optimism, a favorable personality trait and positive psychological resource in which individuals generally hold the expectation of positive rather than the negative outcomes, together with other positive psychological responses to the COVID-19 pandemic have been found to improve subjective wellbeing and mental health (26, 27).

Associated factors related to the COVID-19 pandemic including community shut-down measures, impact on individual's daily lives, risk of infection, and anxiety can be considered chronic stressors. Whereas, family functioning and optimism may be protective against negative emotions and improve life satisfaction (28, 29). However, to date, no studies have assessed life satisfaction and its associated factors including family functioning and optimism among Chinese stroke patients during the COVID-19 pandemic. To better support stroke patients during the COVID-19 pandemic in China, more information is needed on the factors associated with life satisfaction. We hypothesize that:

Demographic and clinical characteristics (including residence, duration of stroke, and stroke type) and epidemic responses (including community shut down measures) could affect life satisfaction;

Family functioning and optimism are positively associated with life satisfaction.

METHODS

Participants and Procedure

A cross-sectional study was employed from April 8 to April 30, 2020, in the general public hospital of Liaoning, China. A total

Abbreviations: COVID-19, The Coronavirus Disease-19; SWLS, Satisfaction with Life Scale; LOT-R, Revised Life Orientation Test; APGAR, Family Adaptation, Partnership, Growth, Affection, and Resolve; ADL, Activities of Daily Living; HMR, Hierarchical Multiple Regression.

of 258 stroke inpatients who were receiving pharmacotherapy, rehabilitation and met the inclusion criteria were consecutive selected in this study and these participants were interviewed face-to-face by the trained investigators using a mobile phone questionnaire via the WeChat platform. The inclusion criteria of stroke patients were the following: age more than 20 years old; fluent in oral or written Chinese, and able to consent to join the study. The exclusion criteria were having a history of serious mental illness or a serious chronic illness including schizophrenia, bipolar disorder, Alzheimer's disease, hysteria, cancer, dementia, or severe hearing or vision impairment. The participant was informed of the research aims and that the questionnaire was anonymous prior to informed consent. The questionnaire took approximately 25 min to complete. The questionnaire had been preset for submission only after all the questions were answered within the range of the selected choices. Answers were not available if the questions were not completed. Therefore, the collected questionnaire had been filtered with data cleaning, checking the consistency and logicity of the answers, adjusting invalid and missing values.

Instruments

The information collected on stroke patient's demographic and clinical characteristics included age, gender, marital status, education level, residence, monthly income, duration of stroke, stroke type, and activities of daily living (ADL). "Marital status" was grouped as "married" or "other." "Residence" was classified as "urban" or "rural." "Education level" was defined as "junior high school and below" or "senior high school and above." "Monthly income (RMB)" was categorized as: " $\leq 3,000$ yuan," "3,001~6,000 yuan" and ">6,000 yuan." "Duration of stroke" was grouped as " ≤ 2 weeks" or "more than 2 weeks." "Stroke type" was classified as "hemorrhagic stroke" or "ischemic stroke." "ADL scores" were categorized as "mild disability (ADL scores ≤ 26)" or "high disability (ADL scores > 26)."

The responses to the COVID-19 pandemic in stroke patients were measured by 4 questions: (1) Community shut-down measures (yes/no), (2) Daily life impact due to the pandemic (yes/no), (3) Perception about the risks of SARS-CoV-2 infection (yes/no), (4) Anxiety about the pandemic (yes/no).

The Family Adaptation, Partnership, Growth, Affection, and Resolve (FAPGAR) Scale was employed to assess the perception of family functioning (30). This scale included five items that were answered on a 3-point Likert scale, ranging from 0 (never) to 2 (always) (30, 28). The Cronbach's alpha coefficient for this scale was 0.936.

Optimism was evaluated by the 6-item Revised Life Orientation Test (LOT-R) that assessed the generalized expectations for positive or negative outcomes. The LOT-R was rated on a 5-point Likert scale from 0 (strongly disagree) to 4 (strongly agree) and the total scores were summed after reverse coding three items (31). The total scores ranged from 0 to 24, with higher scores indicating a greater degree of optimism. The Cronbach's alpha coefficient for this scale was 0.810.

Life satisfaction was assessed by the Satisfaction with Life Scale (SWLS) which was developed by Diener and is widely applied as a valid and reliable measure of life satisfaction for a

variety of populations (32). It comprised of 5 items, to which the participants gave their responses of agreement on a 7-point Likert scale from 1 ("strongly disagree") to 7 ("strongly agree") (33). The Cronbach's alpha for this scale was 0.972.

Statistical Analysis

The statistical analyses were performed using SPSS 22.0 version statistical software for Windows. The radar chart was used to describe significant association factors of life satisfaction for stroke patients during the COVID-19 epidemic. *T*-tests and one-way ANOVA were conducted to compare differences in life satisfaction among the categorical groups. The Spearman correlation was employed to test the correlations between family functioning, optimism, and life satisfaction. Hierarchical multiple regression (HMR) analysis was performed to predict factors associated with life satisfaction, in which, life satisfaction was used as the dependent variable. And the independent variables were entered in four steps: Step 1: stroke patient's demographic and clinical variables; Step 2: epidemic responses; Step 3: family functioning; and Step 4: optimism. A two-tailed probability value of <0.05 was considered statistically significant.

RESULTS

Description of the Stroke Patients and Life Satisfaction

Of the 258 stroke patients, 207 took part in this study and provided valid answers to the questionnaire, resulting in a valid response rate of 80.23%. The demographic and clinical characteristics, and epidemic responses of the stroke patients and the associations with life satisfaction are provided in **Table 1**. The mean age of patients was 64.7 years old (ranging from 33 to 93), and 63.3% of the patients were men. Approximately, 89.4% of the patients were currently married, and 93.7% had a monthly income of $<6,000$ yuan. Of the participants, 23.7% had a stroke duration of more than 2 weeks and 79.7% were diagnosed with a hemorrhagic stroke. Among the stroke patients, 79.2% experienced community shut-down measures during the research study. Patients whose duration of stroke was ≤ 2 weeks reported higher levels of life satisfaction than those whose stroke duration was more than 2 weeks ($P < 0.05$). Patients who lived in urban areas reported higher life satisfaction than those lived in rural areas ($P < 0.05$). Ischemic stroke patients exerted a lower level of life satisfaction than hemorrhagic stroke patients ($P < 0.05$). The stroke patients who lived in communities that were shut-down by the Chinese government had lower life satisfaction than their comparative group ($P < 0.05$). The radar chart of life satisfaction is shown in **Figure 1**.

Correlations of Life Satisfaction and Continuous Variables

The Spearman correlation analyses of life satisfaction, family functioning, and optimism are presented in **Table 2**. Results revealed that family functioning ($r = 0.305$, $P < 0.01$) and optimism were both positively correlated with life satisfaction ($r = 0.296$, $P < 0.01$).

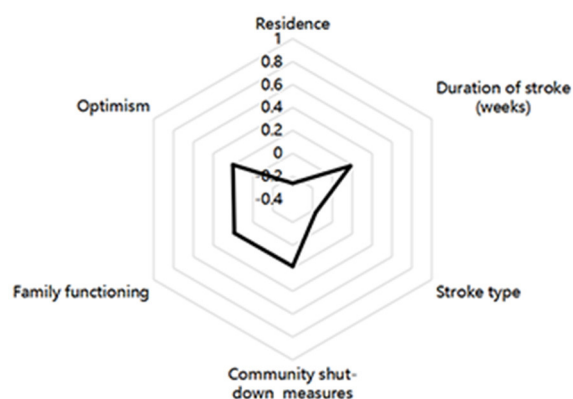
TABLE 1 | Characteristics of the stroke patients and distributions in life satisfaction ($N = 207$).

Variables	N	%	Mean $\pm$ SD
Demographic and clinical characteristics			
Age (yr)			
≤ 65	111	53.6	26.25 $\pm$ 6.78
> 65	96	46.4	26.72 $\pm$ 5.57
Gender			
Male	131	63.3	26.08 $\pm$ 6.57
Female	76	36.7	27.13 $\pm$ 5.59
Marital status			
Married	185	89.4	26.29 $\pm$ 6.45
Others	22	10.6	27.95 $\pm$ 3.79
Educational level			
Junior high school and below	106	51.2	26.81 $\pm$ 6.19
Senior high school and above	101	48.8	26.10 $\pm$ 6.29
Residence			
Urban areas	195	94.2	26.87 $\pm$ 5.82*
Rural areas	12	5.8	19.83 $\pm$ 8.91
Monthly income (RMB)			
$\leq 3,000$	86	41.5	26.02 $\pm$ 6.32
3,001–6,000	108	52.2	26.70 $\pm$ 5.86
$> 6,000$	13	6.3	27.46 $\pm$ 8.64
Duration of stroke (weeks)			
≤ 2 weeks	158	76.3	25.98 $\pm$ 6.17
> 2 weeks	49	23.7	28.02 $\pm$ 6.25*
Stroke type			
Hemorrhagic stroke	165	79.7	26.98 $\pm$ 5.68*
Ischemic stroke	42	20.3	24.42 $\pm$ 7.80
ADL scores			
Mild disability (ADL scores ≤ 26)	117	56.5	26.31 $\pm$ 5.77
High disability (ADL scores > 26)	90	43.5	26.66 $\pm$ 6.82
Epidemic responses			
Community shut-down measures			
Yes	164	79.2	25.93 $\pm$ 6.47
No	43	20.8	28.51 $\pm$ 4.76*
Felt daily life impacts of the pandemic			
Yes	119	57.5	26.07 $\pm$ 6.04
No	88	42.5	27.00 $\pm$ 6.48
Felt the risks of infection with the pandemic			
Yes	155	74.9	26.73 $\pm$ 6.59
No	52	25.1	25.67 $\pm$ 5.00
Felt being anxious about the epidemic			
Yes	54	26.1	25.22 $\pm$ 6.77
No	153	73.9	26.90 $\pm$ 5.99

* $P < 0.05$.

Predictors of Life Satisfaction

Table 3, Figure 2 illustrates the final results of the HMR models of stroke patients' life satisfaction. A total of 25.1% of the variance was explained by the final model. Results from the R^2 change indicated that the variance explained by each block of variables was 15.4, 3.0, 2.9, and 3.8% for demographic and clinical characteristics, pandemic responses, family functioning, and optimism, respectively. Living in the rural areas ($\beta = -1.110$, 95% CI -1.698 – -0.522 , $P < 0.001$) and ischemic stroke ($\beta =$

The significant associated factors of life satisfaction during the COVID-19 epidemic**FIGURE 1** | The radar chart of life satisfaction. Residence (Rural areas); Duration of stroke (> 2 weeks); Stroke type (Ischemic stroke); Community shut-down measures (No).**TABLE 2** | The correlations of life satisfaction and continuous variables ($N = 207$).

Variables	Mean	SD	Range	1	2	3
1. Life satisfaction	26.46	6.23	5~35	1		
2. Family functioning	7.29	2.58	0~10	0.305**	1	
3. Optimism	12.92	2.45	5~24	0.296**	0.206**	1

** $P < 0.01$.

-0.420 , 95% CI -0.772 – -0.069 , $P < 0.05$) were observed to decrease life satisfaction, while more than 2 weeks duration of stroke ($\beta = 0.428$, 95% CI 0.080 – 0.776 , $P < 0.05$) and from an area without community shut-down measures ($\beta = 0.452$, 95% CI 0.077 – 0.827 , $P < 0.05$) were observed to increase life satisfaction. Moreover, stroke patients who had better family functioning ($\beta = 0.188$, 95% CI 0.047 – 0.330 , $P < 0.01$) and optimism ($\beta = 0.202$, 95% CI 0.073 – 0.331 , $P < 0.01$) were observed to experience higher life satisfaction.

DISCUSSION

Principal Findings

Although the COVID-19 pandemic in China was nearly quelled after 3 months, a paucity of research has been conducted on the extent to which the pandemic affected stroke patient's subjective wellbeing in hospitals. More importantly, this survey represents the first cross-sectional study on the association of family functioning and optimism with life satisfaction among the population of stroke patients during the COVID-19 pandemic. The present study showed that the levels of life satisfaction in Chinese stroke patients was higher than those in general public of other countries and university students in Poland during the first peak of COVID-19 pandemic (34, 35). The reason for this phenomenon might be that COVID-19 outbreak was under control with serene and spacious medical environment (36). Shenyang was less influenced by COVID-19 pandemic and was

TABLE 3 | The hierarchical regression analysis of life satisfaction ($N = 207$).

Variables	Beta	Standardized beta	95%CI of beta	t-value	P value	R ²	ΔR ²
Block1 demographic and clinical characteristics						0.154	0.154
Age	0.026	0.026	-0.107 0.160	0.390	0.697		
Gender (Male vs. Female)	0.209	0.101	-0.066 0.485	1.498	0.136		
Marital status (Married vs. Other)	0.406	0.126	-0.042 0.855	1.785	0.076		
Educational level (Junior high school and below vs. Senior high school and above)	-0.225	-0.113	-0.508 0.058	-1.567	0.119		
Monthly income (RMB) ($\leq 3,000$ vs. 3,001–6,000)	0.106	0.053	-0.184 0.395	0.718	0.474		
MMonthly income (RMB) ($\leq 3,000$ vs. 3,001–6,000)	0.375	0.091	-0.198 0.948	1.291	0.198		
Residence (Urban areas vs. Rural areas)	-1.110	-0.260	-1.698 -0.522	-3.724	0.000**		
Duration of stroke (weeks) (≤ 2 weeks vs. > 2 weeks)	0.428	0.182	0.080 0.776	2.424	0.016*		
Stroke type (Hemorrhagic stroke vs. Ischemic stroke)	-0.420	-0.169	-0.772 -0.069	-2.357	0.019*		
ADL scores (Mild disability (≤ 26 scores) vs. High disability (> 26 scores))	-0.059	-0.030	-0.358 0.240	-0.391	0.696		
Block2 epidemic responses						0.184	0.030
Community shut-down measures (Yes vs. No)	0.452	0.184	0.077 0.827	2.375	0.019*		
Felt daily life impacts of the pandemic (Yes vs. No)	-0.045	-0.022	-0.325 0.235	-0.315	0.753		
Felt the risks of infection with the pandemic (Yes vs. No)	-0.084	-0.036	-0.434 0.266	-0.472	0.638		
Felt being anxious about the epidemic (Yes vs. No)	0.090	0.040	-0.261 0.441	0.505	0.614		
Block3 Family functioning	0.188	0.188	0.047 0.330	2.630	0.009**	0.213	0.029
Block4 Optimism	0.202	0.202	0.073 0.331	3.095	0.002**	0.251	0.038

* $P < 0.05$; ** $P < 0.01$.

in a low risk are in China compared with others (37). Besides, during the COVID-19 pandemic, a series of hospitals have provided prevention and management protocols to offer quality and continuous care for stroke patients, such as providing green channels with personal protective equipment, implementing group management in the process of diagnosis and treatment to avoid cross-infection (38), stroke patients with non-infectious were provided in separate rooms with more meticulous, assured health and psychological care, which resulted in the enhancement of life satisfaction (39).

The results from this study indicate that demographic and clinical factors were critical to interpret life satisfaction among stroke patients, accounting for 15.4% of the observed variance in stroke patient's subjective wellbeing. Furthermore, individual's internal support or psychological resources like family functioning and optimism, played critical roles in promoting life satisfaction, which corroborates previous research illustrating that positive beliefs could affect the appraisal of the stress response, help individuals facilitate and adapt to the stressful settings and tackle difficulties, which could improve stroke patient's life satisfaction (40).

Residence, duration of stroke, stroke type, and epidemic responses with community shut-down measures were strong predictors of life satisfaction for stroke patients during the COVID-19 pandemic. Stroke patients living in cities experienced slightly higher levels of life satisfaction during the COVID-19 pandemic. The most likely reason is that, Chinese stroke patients living in urban areas tend to obtain quality medical care in tertiary hospitals, which would be conducive to current life quality, psychological health, and subjective wellbeing (41). A longer stroke duration was positively associated with life satisfaction, which is in accordance with a previous research

suggesting that the patients have adapted to the disease control and management (42). Ischemic stroke was a risk factor for poor life satisfaction among stroke patients. This may be because patients with ischemic stroke are more prone to hemiplegia, slurred speech, crooked mouth and other clinical symptoms, leading to a poorer prognosis and thus may cause ischemic stroke patients to have a lower subjective wellbeing (43). In addition, stroke patients who did not experience community shut-down measures during the COVID-19 epidemic were more satisfied with their life, which has been also shown by Fan et al. (44).

This study found that family functioning was moderately and positively associated with life satisfaction, which confirmed that a higher familial sense of togetherness, familiarity, and satisfaction with family ties contributed to improved psychological wellbeing for stroke patients when they faced a public health emergency (21, 45). Most research has shown that people who have stronger familial cohesion and communication have more positive perceived family roles and responsibilities, and thus, higher life satisfaction (46, 47). Conversely, poor family relationships and negative caregiving experiences could decrease the sense of life satisfaction for stroke patients. Accordingly, sufficient family support and positive experiences of caregiving from both family caregivers and hospital workers were related to higher life satisfaction for stroke patients during the COVID-19 epidemic.

In this study, optimism was positively associated with life satisfaction, which was in agreement with studies showing that optimistic stroke patients were more likely to have higher subjective wellbeing during the COVID-19 pandemic (48). The greater family support that stroke patients received, the higher optimism levels they had, which made stroke patients believe that positive events would continuously and universally take place, thereby increasing their life satisfaction (49). Attribution

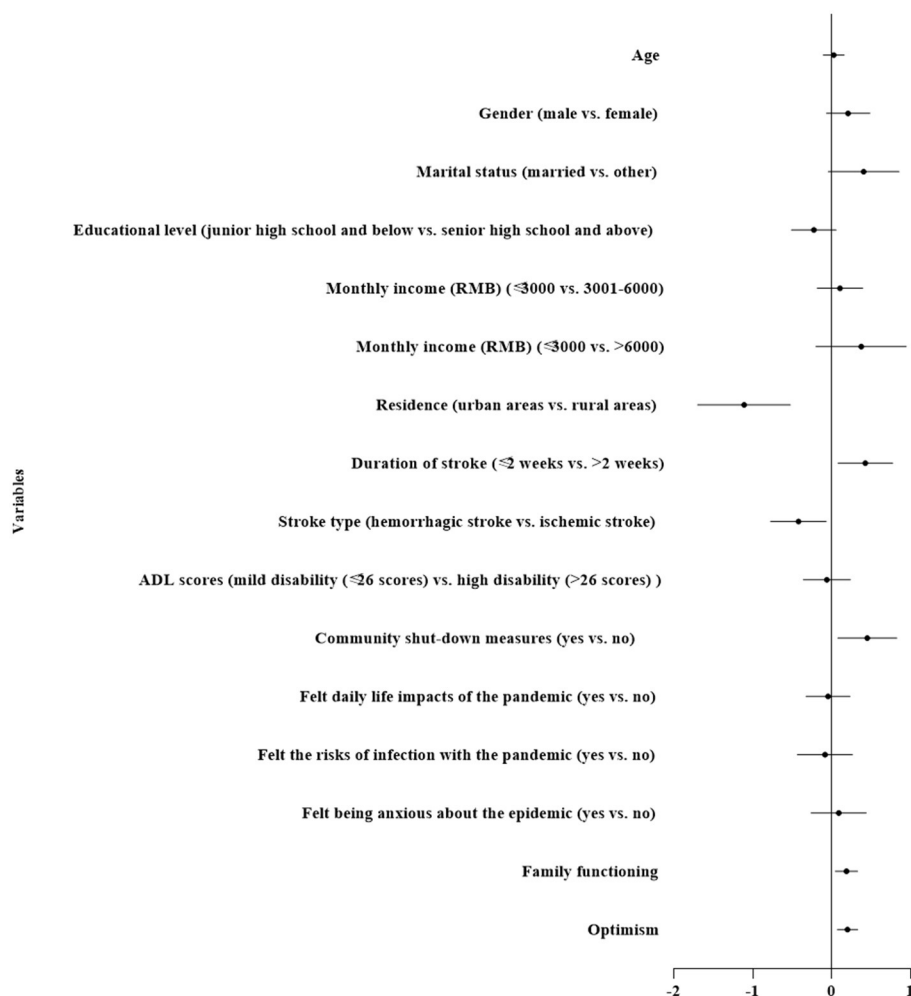


FIGURE 2 | The forest plot of associate factors of life satisfaction.

theory states that individuals with optimism appraise difficult circumstances (e.g., the COVID-19 pandemic) in a positive way and have a more hopeful outlook regarding the future, which leads to improved life satisfaction (50). Conversely, patients with low levels of optimism might tackle the difficult events in a more negative way and have bleak expectations for their future, which could result in the reduction of life satisfaction among stroke patients (51). Therefore, investment in enhancing optimism and family functioning may be effective in reducing the negative effects of public health emergencies and improving perceived subjective wellbeing.

LIMITATIONS

There are several limitations in the present research. First, the data were selected from one hospital in Shenyang with a relative small sampling, which did not allow for generalization of the findings to stroke patients in other areas, or globally, during the COVID-19 pandemic. Therefore,

expanding hospitals and participants to increase the results of generalizability should be prominent in the future study. Second, this was a cross-sectional study, thus, the causal relationships between optimism, family functioning, and life satisfaction require further research. Therefore, future research should utilize a longitudinal design during the pandemic to better establish the direction of relationships between the research variables.

CONCLUSION

The life satisfaction of Chinese stroke patients was relatively high. Family functioning and optimism exerted strong positive association with life satisfaction. This study contributes to a better perspective on the protective factors of family functioning and optimism on life satisfaction among stroke patients during the COVID-19 pandemic. The training on the skills of family functioning and optimism enhancement intervention should be provided in order to elevate of life satisfaction for stroke patients.

Therefore, optimism intervention including face-to-face or online training conducted by training facilitators with series activities in-person and group-based should be conducted to improve stroke patients' levels of optimism, enhancing their ability to cope with stress adversities, improving positive psychological resources and establish a preventive mechanism without suffering mental illness and finally improve their life satisfaction (52). In addition, given the influence of family function on life satisfaction among stroke patients, it is necessary to customize family service programs to improve effective connections and positive interaction within the family, giving patients more spiritual and material support and reducing the burden of family care, thereby improving the family relationship and function, increasing patient's life satisfaction and promoting superior recovery.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by China Medical University. The patients/participants

provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

YS and CC contributed to acquisition and analysis of data, drafting, and revision of the manuscript. YJ contributed to revision of the manuscript. WZ contributed to acquisition and analysis of data. LM contributed to acquisition data and the statistical analysis. KS contributed to revision of the manuscript and provide English edits. YX contributed to acquisition of data. XY was responsible for the conception and design. All authors contributed to the article and approved the submitted version.

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COVID-19 Information Overload, Negative Emotions and Posttraumatic Stress Disorder: A Cross-Sectional Study

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Background: Under the context of the COVID-19 pandemic, a large amount of COVID-19-related information can cause an individual's perceived information overload, further halting the individual's psychological health. As a minor psychological discomfort could develop severe mental disorders such as posttraumatic stress disorder, it is necessary to understand the chain linkage of COVID-19 information overload turn to posttraumatic stress disorder to ensure timely intervention can be offered at each point of mental state transformation. Hence, we examined the negative outcomes of COVID-19 information overload and investigated the direct and indirect effects of COVID-19 on posttraumatic stress disorder.

Methods: A convenient sample of Chinese adults ($n = 1150$) was investigated by an online survey from July 2020 to March 2021. The extent of COVID-19 information overload was measured by the information overload severity scale on the text of the COVID-19 pandemic. Psychological distress symptoms were measured using a 7-item anxiety scale (GAD-7), the 9-item Patient Health Questionnaire depression module (PHQ-9), and the psychometric properties of the PTSD Checklist (PCL-C). Structural equation modeling and bootstrap methods were utilized to analyze the relationships between variables.

Results: COVID-19 information overload is positively related to an individual's anxiety, depression, and posttraumatic stress disorder. Furthermore, COVID-19 information overload can indirectly affect an individual's PTSD symptoms by increasing the feeling of depression. R^2 values of anxiety, depression, and PTSD were 0.471, 0.324, and 0.795, respectively.

Conclusion: COVID-19 information overload, anxiety, depression, and PTSD are negative psychological states, and each variable is closely linked with the others, suggesting the need for potential psychological interventions at specific times. Practical public training, such as crisis coping and information filtering, is essential. Regulation of technology companies is also essential.

Keywords: information dissemination, posttraumatic stress disorder, depression, anxiety, mental health, nursing, COVID-19

INTRODUCTION

In December 2019, the first evidence of the novel coronavirus disease (COVID-19) was found in China. Within a short period of time, the disease spread rapidly throughout the world, and by January 2022, there had been more than 38 million cases of COVID-19 in 188 countries (1). People across the globe have experienced great life-changing events as a result of the disease's high morbidity and mortality (2). On January 30, 2020, the World Health Organization announced that COVID-19 was a public health emergency of international concern (2). The government took immediate action to restrict the spread of COVID-19 and encouraged people to take initiative to prevent a pandemic (3). Multimedia was utilized, such as television, social media, newspapers, and online websites, to inform people about the details of the disease, including potential symptoms, precautionary measures, and supportive services (4, 5). Individuals, concerned about contracting the disease and overcoming the uncertainty caused by conflicting information, began to search online and offline media for related information to keep themselves informed about COVID-19 (6–8). Hence, people were exposed to a vast amount of information.

The rapid spread of COVID-19 information resulted in an escalation of destructive effects (1). Further, accessing and processing a huge amount of information in a limited time can be burdensome and stressful, causing information overload (9). Meanwhile, some information sources lacked rigorous management of the accuracy and truthfulness of COVID-19-related information (10–12). This left individuals to filter misleading information, conspiracy theories, which exacerbated information overload (10).

Information overload was first defined by Toffer in the 1970s and has been investigated by many scholars (13). Information overload is defined as a situation in which the volume of information is beyond an individual's coping capacity (14). Prior research confirmed that information overload can cause individuals to become cognitively burdened and dysfunctional (15). When it becomes clear to an individual that he or she can no longer process a large amount of complex information, he or she will attempt to enhance coping abilities, which can be accompanied by stress, anxiety, depression, and feelings of being overwhelmed (2, 16). Furthermore, in the context of COVID-19 pandemic, the rapid dissemination of the false information, conspiracy theories amplified the negative emotions stem from COVID-19 information overload (17).

There are several empirical studies that revealed the relationship between COVID-19 information overload and anxiety (9, 18–20). Since the outbreak of COVID-19, characters have accessed a huge amount of COVID-19-related information, which is an energy-draining experience for those who do not possess deep prior medical knowledge to filter reliable and validate information from a large volume of information and make full sense of this information. While individuals are aware of the inability to make sense of perceived information, they might feel anxiety (9). Meanwhile, the wealth of information on websites about the diagnosis and symptoms of COVID-19 may mislead individuals to believe they are infected, even though some symptoms are common to multiple diseases, which inadvertently contributes to individual anxiety (9). For incidence, Saira et al. indicated the linkage between the source of COVID-19 information, COVID-19 information overload, and information anxiety, confirming that COVID-19 information overload is a strong predictor of anxiety (13).

Furthermore, during the New Coronary Pneumonia Pandemic, the social distance and isolation required by epidemic prevention policies can result in a wide range of negative emotions in individuals, such as depression, sadness, and loneliness (1). To buffer these uncomfortable feelings stemming from isolation and staying connected to the outside world, individuals tend to engage in social media or online resources much more, which exacerbates the extent of COVID-19 information overload (18). However, the amount of intricate information available in a short period of time is difficult for the individual to process, resulting in stress, which is a key factor of depression (10). Several empirical studies have also confirmed the relationship between COVID-19 information overload and depression. For example, a study conducted in Hong Kong indicated that higher COVID-19 information overload scores showed more severe depression symptoms (10). Moreover, Matthes tested the association between information overload and depression in a two-wave panel study and confirmed that there is a longitudinal relationship between information overload and depression (21). Numerous studies have examined the adverse outcomes of COVID-19 information overload, such as negative emotions, information fatigue, and information avoidance (2, 6, 18, 22). However, the adverse effects of COVID-19 information overload go far beyond these responses. The rapid spread of COVID-19 as well as the high mortality rate result in a negative psychological state, trigger an individual's stress, causing individuals to experience a variety of negative emotions, such as anxiety and depression (23, 24). When

symptoms of acute stress disorder as negative emotions do not receive timely intervention, it may further occur as posttraumatic stress disorder (PTSD) (25).

In the context of COVID-19 pandemic, large amount of people was infected, caused not only the rise of disease burden as well as economic loss, but also psychological issues, especially the onset of posttraumatic stress disorder (PTSD) (26). PTSD was defined as delayed and prolonged psychiatric disorders following catastrophic or threatening trauma events to the individual. The disorder can be characterized by flashback, persistent avoidance, heightened alertness, selective amnesia, traumatic memories and loss of confidence (27), which is a severe life disrupting mental disorder. PTSD can lead to social dysfunction in individuals, causing seriously impairs quality of life, increasing the burden of disease on families and society (28–30).

There is evidence that negative emotions such as anxiety and depression are associated with PTSD. Empirical studies have shown that a variety of negative emotions, such as anxiety, depression, guilt, anger and depression, are associated with PTSD (31, 32). The established literature has clearly indicated that a high level of COVID-19 information overload has negative psychological and physiological consequences (6, 10, 13). Furthermore, more negative emotions predict the symptoms of PTSD (33). Therefore, it is likely that high levels of COVID-19 information overload indirectly affect the severity of PTSD symptoms by affecting anxiety and depression levels. Investigating the relationship between COVID-19 information overload, negative emotions and PTSD symptoms can deepen the understanding of PTSD in the context of COVID-19 pandemic, providing theoretical basis for psychological intervention in each key node.

However, whether COVID-19 information overload contributes to the occurrence of PTSD symptoms is still unknown. There are limited studies that have investigated the relationship between the variables. Hence, this study aimed to clarify the relationship between COVID-19 information overload and negative emotions such as anxiety and depression and PTSD symptoms, ensuring that accurate preventative measures can be offered at every key node in this process of negative changes in psychological states.

METHODS

Study Design

A cross-sectional study carried out by 1150 subjects

Subjects

This study was conducted from July 2020 to March 2021. A total of 1,302 subjects volunteered to participate in the study and were included. The inclusion criteria were as follows: (1) older than 18; (2) no cognitive impairment, for incidence, individuals who with severe dementia, in clouded consciousness, into stupor, in coma, fail to communicate due to severe psychiatric disorders or vegetative state were excluded; and (3) no severe somatic diseases, for incidence, those who currently suffer from cancer, acute trauma, shock were not include in this study. The exclusion criteria were as follows: (1) Not willing to participate in this study.

The initial sample size (1067) was calculated by the formula $N = Z^2 \times (P \times (1-P))/E^2$ ($Z = 1.96$, $E = 3\%$, and $P = 0.5$). Due to the possibility of sample dropout, 1302 subjects were invited to finish the survey. Finally, 1150 (88.32%) individuals finished the study. Those who withdrew from the study in the middle stage, for incidence, unable to continue this study due to personal matters, unable to understand the content of the questionnaires, and the answer sheets not available due to poor quality were removed from this study (235, 11.68%).

Data Collection

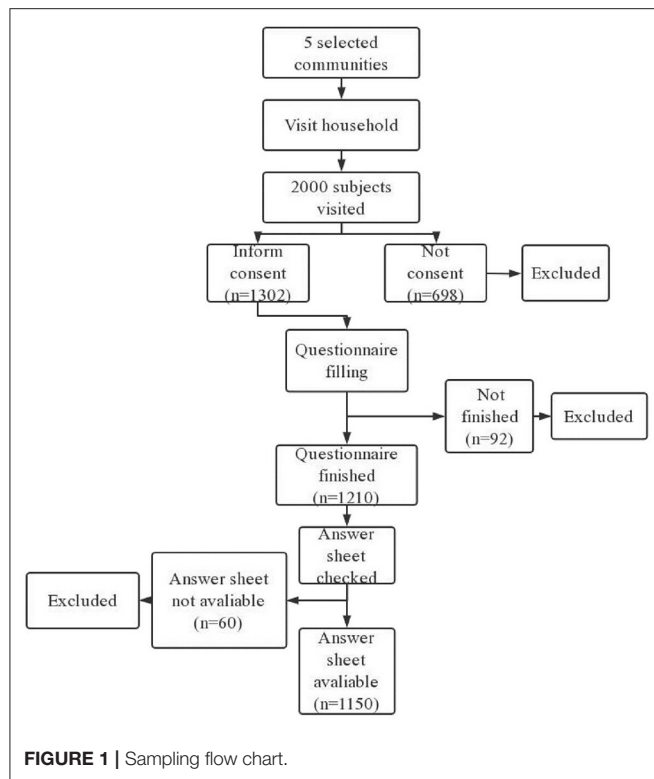
Before data collection, five communities were selected (Guojia Bridge Community, Nanhong Village Community, Shuangnan Community, Tangmen Street Community, Parachute Tower Community). The five community were all located in Wuhou District, with a total resident population of over 5,000 citizens. Leaders of three of the selected communities (Guojia Bridge Community, Tangmen Street Community, Parachute Tower Community) agreed to participate in this study. Data were collected by three well trained researchers. A WeChat message including the research proposal, precautions, and questionnaires was sent to each selected participant. Then, an online questionnaire was conducted to collect data. The most commonly utilized software, WJX (www.wjx.com), was used. Participants responded to questions about COVID-19 information overload, anxiety, depression, and symptoms of PTSD. In order to make sure the accuracy of each answer sheet as well as reduce bias, strict quality control measures were adopted. For example, each questionnaire cannot be submitted until all the questions were answered. One person could only fill in the questionnaire once after all the topics were completed. Each questionnaire was screened by automatic screening rules and manually checked by the researchers after submission. Any answer that did not meet the requirements, such as only one option was selected or the questionnaire was finished within 60 s, was marked as invalid and then removed. The details of the process of sampling shown in (Figure 1).

Measurements

Mature measurements were adopted to ensure the accuracy of the study and the severity of information overload regarding text about the COVID-19 pandemic (34). The 7-item anxiety scale (GAD-7), the 9-item Patient Health Questionnaire depression module (PHQ-9); the psychometric properties of the PTSD Checklist (PCL) were utilized to measure individuals' COVID-19 information overload, anxiety, depression, and symptoms of PTSD.

The Information Overload Severity Scale on Text About the COVID-19 Pandemic

The scale was developed by Yang et al. in 2021 and consists of seven items measured on a five-point Likert scale, with higher scores representing more severe information overload (34). The scale has good reliability and validity, and previous study indicated that the total Cronbach's α coefficient of the scale was 0.863 (34). The total Cronbach's α coefficient of the scale in this study was 0.867.



The 7-Item Anxiety Scale (GAD-7)

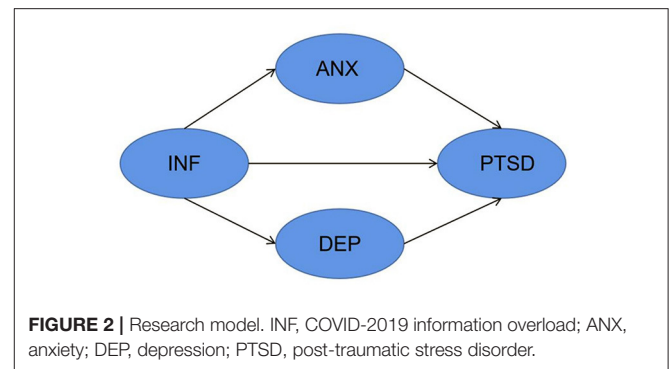
The GAD-7 scale is a simple and effective assessment tool for the identification of generalized anxiety disorder. It is widely used overseas with a sensitivity of 86.8% and a specificity of 93.4%. The scale includes both somatic and cognitive/emotional scores, which are sensitive and simple to use (35). GAD-7 scores of 5-9, 10-14, and 15-21 represent mild, moderate, and severe anxiety, respectively (35). The total Cronbach's α coefficient of the scale in this study was 0.922.

The 9-Item Patient Health Questionnaire Depression Module (PHQ-9)

The PHQ-9 scale was developed by Columbia University in the mid-1990s and is a self-assessment scale specifically designed to screen for mental disorders in primary health care settings (36). The PHQ-9 scale is more streamlined than other scales, and scores of 5-9, 10-14, 15-19, and 20-27 represent mild, moderate, moderate-severe, and major depression, respectively (37). The total Cronbach's α coefficient of the scale in this study was 0.919.

The PTSD Checklist-Civilian Version(PCL-C)

The PCL-C is a 17-item PTSD symptom questionnaire developed in November 1994 by the Behavioral Sciences Division of the American Center for PTSD Research and based on the DSM-IV (38). The PCL-C scale is designed to evaluate the experiences of ordinary people after experiencing trauma events in ordinary life (as opposed to war). It asks subjects to rate themselves according to how much they have been disturbed by problems and complaints in the past month on a five-point Likert scale,



with higher scores representing more severe PTSD symptoms. The total score of each item was summed to determine the presence and severity of PTSD. In the United States, the PCL-C scale is often used as an evaluation scale for the diagnosis of PTSD symptoms and the evaluation of the effectiveness of interventions for the treatment of PTSD (39). The total Cronbach's α coefficient of the scale in this study was 0.947. PTSD was considered to be present when the total score exceeded 50 (40, 41).

Ethical Consideration

Prior to conducting this study, an application was submitted to the Ethics Committee of West China Hospital Sichuan University. All the details about the research, as the research methods, measurements that intended to be utilized in this study, inclusion as well as exclusion criteria, research procedure were clarified in the application. After carefully review by the Ethics Committee of West China Hospital Sichuan University, the study obtained approval to conduct (No. K202006). All the participants were informed of all the details of this study and the signed informed consent form were obtained.

Hypothesis and Research Model

To clarify the relationship between COVID-19 information overload and negative emotions and PTSD symptoms and investigate whether anxiety and depression have a mediation role between COVID-19 and PTSD symptoms, the following hypothesis were presented:

H1: COVID-19 information overload is positively associated with perceived anxiety and depression.

H2a: Anxiety is positively associated with an individual's PTSD symptoms.

H2b: Depression is positively associated with an individual's PTSD symptoms.

H3a: COVID-19 information overload indirectly affects the severity of PTSD by affecting anxiety.

H3b: COVID-19 information overload indirectly affects the severity of PTSD by affecting depression.

H3c: COVID-19 information overload is positively associated with individuals' PTSD symptoms.

A research model was constructed to test the hypothesis above (Figure 2).

Data Analysis

Since the purpose of this study is to test the proposed hypothesis, the Structural Equation Model was utilized. Structural equation model (SEM) is a statistical methods which is substantially utilized in psychology and social science. Compare to the other analyze strategies, SEM allows for confirmatory analyze, offering a comprehensive approach to evaluate and revise the theoretical model. Furthermore, SEM can also facilitate researchers to conduct simultaneous multiple mediating effects analysis, multiple mediation variables can be analyze simultaneously (42). Compare to the analysis of simple mediating effects, the total mediating effect can be obtained by utilizing SEM to establish multiple mediating effects. In addition, the mediating effect of each specific variable can be investigated with a premise that the other mediating variables are controlled. Comparative mediating effects can also be obtained by utilizing SEM, making it possible for the researchers to determine which mediating variable has a stronger effect (43). Therefore, the Structural Equation Model was utilized in this study. Before SEM conducted, the correlation between demographic factors and PTSD symptoms were tested, with a significance level of $p < 0.05$. Only demographic variables that were associated with PTSD symptoms were considered to be controlled.

IBM AMOS software 23.0 was adopted for data analysis. Before the path analysis, we conducted an initial screening to check the normality of the data. The bootstrapping procedure was utilized since the data in this study did not conform to a normal distribution. The two-step approach proposed by Anderson and Gerbing was adopted to test the research model as well as all the hypotheses (42). In the first step, model fit indices were utilized to check the degree of model fit. Further, the quality of the model was reflected by reliability and validity. The discriminant validity, convergent validity, construct reliability were tested (42). Discrimination validity was analyzed by calculating the correlation coefficient, which indicated the difference between two factors. Convergent validity was analyzed by testing the average variance explained (AVE). AVE is used to calculate the average variance explained by each measurements of the latent. Construct reliability was analyzed by composite reliability (CR). This indicator is a measurement of the degree of consistency of potential variables (42). In the second step, the path coefficient (β) and coefficient of determination (R^2) were tested to examine the relationship between variables. In addition, the mediating roles of anxiety and depression were also analyzed by using a bootstrapping procedure with a sample size of 5,000 and a significance level of 0.05. The model was adjusted by modification index.

RESULTS

Demographic Characteristics

There are 1150 subjects participated in this survey, including 410 male (35.7%), 740 female (64.3%), mean age 37.70 ± 13.91 . 95(8.3%) participants were junior high school education experience and below, 151(13.1%) participants are senior high school educated. Most of the participants (796, 69.2%) has a college degree. 62.8% [722] of the participants are married.

TABLE 1 | Demographica characteristics among participants.

Characteristics	N(%)	Z(H)
Gender		
Male	410(35.7)	−0.341
Female	740(64.3)	
Age		
≤ 27.00	306(26.6)	3.249
28.00–34.00	270(23.5)	
35.00–49.00	292(25.4)	
50.00+	282(24.5)	
Educational background		
Junior high school and below	95(8.3)	1.068
Senior high school	151(13.1)	
College degree	796(69.2)	
Bachelor degree and above	108(9.4)	
Marital status		
Unmarried	340(29.6)	3.790
Married	722(62.8)	
Divorced and other	88(7.6)	
Neighborhoods infected status		
Yes	42(3.7)	−2.884***
No	1108(96.3)	
Being considered as suspected or confirmed cases of COVID-19		
Yes	12(1.0)	−0.903
No	1138(99.0)	

***Indicated that $p < 0.005$.

42(3.7%) subject's neighborhoods had been infected by COVID-19. 12 (1.04%) of the participates were considered to be suspected or confirmed cases of COVID-19. Neighborhoods infected status was indicated to be related with individual's symptoms of PTSD (Table 1).

$$N = Z^2 \{P \times (1 - P)\} / E^2 \quad (1)$$

Individuals' COVID-19 Information Overload, Anxiety, Depression, and PTSD

According to the study, 36.0% had moderate anxiety, and 13.3% had severe anxiety. A total of 438(38.1%) of subjects had a moderate level of depression, 213 of the participates (18.5%) suffered from moderate-severe depression, 109(9.5%) suffered from major depression. Twenty-six subjects (2.3%) were considered to positive for PTSD screening, which indicated that the 26 participates may suffer from PTSD (Table 2).

Measurement Model

The model fit was evaluated using different goodness-of-model fit indices. A measurement model was used by confirmatory factor analysis (CFA). To confirm good model fit, different thresholds

TABLE 2 | Individual's COVID-2019 information overload, anxiety, depression, PTSD status.

Variables	Mean $\pm$ SD	Severity	(N,%)
COVID-2019 information overload	8.82 $\pm$ 5.23		
Anxiety	10.61 $\pm$ 5.04	Mild	583 (50.7)
		Moderate	414 (36.0)
		Severe and above	153 (12.3)
Depression	12.89 $\pm$ 4.84	Mild	390 (33.9)
		Moderate	438 (38.1)
		Moderated-severe	213 (18.5)
		Major	109 (9.5)
PTSD	24.4 $\pm$ 8.87	Non PTSD	1124 (97.7)
		Positive for PTSD	26 (2.3)

PTSD, Post-Traumatic Stress Disorder.

were proposed by scholars: chi-square/degree of freedom (X^2/df) < 3 , Comparative Fit Index (CFI) ≥ 0.95 , Tucker–Lewis Index (TLI) ≥ 0.95 , and Root Mean Square Error of Approximation (RMSEA) ≤ 0.05 (44). In our study, the measurement model indicated good fit ($X^2/df = 1.185$, $P = 0.210$, CFI = 0.999, TLI = 0.999, RMSEA = 0.013, GFI = 0.995).

Validity and Reliability

Discriminant Validity

Discriminant validity refers to the extent to which study constructs are significantly different from each other. Different threshold values were proposed by researchers to determine whether sufficient discriminant validity exists. The Fornell–Larker criterion and the inter-measurement correlation were tested (45). According to the Fornell–Larker criterion, the value of the inter-measurement correlation is supposed to be smaller than the square root of the average variance explained (AVE) for each research measurement. According to Brown et al., the correlation between each variable should not be >0.8 . This is essential to distinguish significantly between any two given measurements because possible redundancy as well as possible covariance between the two given measurements might exist if the correlation value exceeds this threshold (46). The measures in this study fulfilled all these criteria, indicating sufficient discriminant validity of the study (Table 3).

Convergent Validity

The degree to which a measure reflects the same essential concept indicates convergent validity. Different standards to verify the existence of sufficient convergent validity were proposed by researchers, as the factor loadings should be higher than 0.70 (47). The AVE values are supposed to be higher than 0.50, indicating that a given metric possesses at least half of the variance to be explained (47). The measures in this study fulfilled all these criteria, indicating sufficient convergent validity of the study (Table 4).

Construct Reliability

Composite reliability (CR) was tested to investigate the construct reliability of these study measures. Adequate construct reliability was established when the CR exceeded 0.70, according to Clark and Watson (48). The measures in this study fulfilled all these criteria, indicating composite reliability (Table 3).

Structural Model

The structural model was evaluated using structural equation modeling (SEM). Through this approach, we investigated the relationship between information overload as a condition prior to anxiety, depression, and PTSD and the effect of anxiety and depression on PTSD. Different research hypotheses were developed according to the size and significance of the structural paths. In addition, the squared multiple correlation (R^2) values were tested to ascertain the proportion of variance explained in the dependent variable. We identified the potential correlations of the study measures on the basis of significance levels and squared multiple correlation values. The path coefficients and significance levels are given in Figure 1 (Figure 3). The R^2 values of anxiety, depression, and PTSD were 0.471, 0.324, and 0.795, respectively, indicating that 47.1% of the variance in anxiety, 32.4% of depression, and 79.5% of PTSD can be explained. COVID-19 information overload was positively associated with anxiety ($\beta = 0.687$, $p < 0.001$), depression ($\beta = 0.569$, $p < 0.001$), and symptoms of PTSD ($\beta = 0.190$, $p < 0.001$), and depression was positively associated with symptoms of PTSD ($\beta = 0.757$, $p < 0.001$). Therefore, H1, H2b, H3c accepted, H2a rejected.

The Mediating Effect of Anxiety and Depression

To confirm whether COVID-19 information overload indirectly influences individuals' PTSD symptoms by affecting anxiety and depression, the bootstrap method was adopted. We defined special syntax to perform the analysis of mediating effects; ind1 indicated the indirect effects of COVID-19 information overload which mediated by anxiety, and ind2 indicated the indirect effects of COVID-19 information overload which mediated by depression. The direct effect of COVID-19 information overload and total effects or the sum of ind1, ind2, direct effect were also calculated (Table 5). According to the mediating analyze, H3b accepted, H3a rejected.

DISCUSSION

This study provides novel insights associated with COVID-19 information overload and its impact in the pandemic context. The antecedents, measurements, incidence rates, causes, and effects of COVID-19 information overload on mental health are widely studied (2, 6, 9, 10, 22); however, in addition to negative emotions and psychological illness, chain effects need to be considered. Therefore, according to previous studies that indicated a relationship between COVID-19 information overload and anxiety, depression, and PTSD symptoms (9, 10, 49, 50), we investigated the relationships among these variables. We found that COVID-19 information overload has a small direct effect on the development of PTSD symptoms; moreover,

TABLE 3 | Mean, Standard deviation, convergent and discriminant validity.

Variables	MEAN	SD	CR	AVE	INF	ANX	DEP	PTSD
INF	8.82	5.23	0.850	0.653	0.808			
ANX	10.61	4.04	0.917	0.787	0.61	0.887		
DEP	12.89	4.84	0.914	0.781	0.487	0.704	0.884	
PTSD	24.4	8.77	0.910	0.772	0.566	0.696	0.747	0.877

INF, COVID-2019 information overload; ANX, anxiety; DEP, depression; PTSD, post-traumatic stress disorder.

CR, Composite Reliability.

AVE, Average Variance Explained. Bold values means factor loading of the variables.

COVID-19 information overload can affect the development of PTSD symptoms indirectly by affecting an individual's self-reported depression, which offers a new perspective on interventions for PTSD. The results of the study also confirmed that COVID-19 information overload was positively associated with anxiety and depression, which is in accordance with previous studies (2, 10). As a small psychological discomfort can subsequently turn into a serious mental illness, our findings have clinical implications (21).

The results of the study indicated that depression mediated the process of COVID-19 information overload leading to PTSD symptoms. According to Matthes's findings, COVID-19 information overload can be a trigger of depression (21). A large amount of information on a wide range of topics appears on websites and forums, and comments on this information, which exceed individuals' information processing ability, can result in frustration and lead to depression (9). Moreover, depressed individuals are more inclined to spend much more time on social media and online information resources, which forms a vicious cycle (51). When depression accumulates it may lead to PTSD. An investigation conducted by Breslau *et al.* showed that there may be multiple relationships between PTSD and depression: patients with PTSD and those with depression have similar personality traits. PTSD and depression may also be causally related to each other (52). According to Yaacoub's study, the relationship between depression and PTSD can be explained by feelings of insecurity, which lead to a more distorted memory of the event and to more intense emotions and hurt. This aggravation of an already distressing trauma increases the chances of developing PTSD (49). Therefore, COVID-19 information overload might affect individuals' PTSD symptoms through the psychological pathways mentioned above.

In this study, we also found a small direct association between COVID-19 information overload and PTSD symptoms. According to the symptoms of PTSD, when PTSD patients are exposed to information related to a traumatic event or an environment that resembles the traumatic event, they experience intense feelings of discomfort, such as fear, panic, and depression (53). Therefore, the widespread circulation of COVID-19-related information might lead to increased exposure to events or environments related to traumatic memories. In addition, we deduce that the infodemic of fake news, conspiracy theories, and polarizing information might amplify feelings of insecurity,

which is an essential sensation that causes PTSD. Hence, COVID-19 information overload may directly affect PTSD levels in these ways.

In our study, the relationship between COVID-19 information overload and anxiety and depression was also validated. In accordance with prior studies, COVID-19 information overload is positively associated with anxiety and depression (10). Therefore, COVID-19 information overload is an important contributor to the negative impact on people's psychological states in the short or long term (10). The rapid rise in new cases of COVID-19 around the world and the subsequent changes in everyday living are causing panic and stress (23, 54). Information overload and rumor spreading during the pandemic added additional psychological burden to the public, affected the risk perception of individuals, decreased confidence in fighting the disease, and became a catalyst for disrupting individuals' well-being (55). If timely action is not taken to provide the public with psychological guidance, the accumulation and fermentation of negative emotions will cause deeper damage from the initial temporary negative emotions to the development of serious PTSD symptoms (55). In this process of negative changes in psychological states, each node is the key to psychological prevention, and effective measures should be taken to mediate the chain-like deterioration of individuals' well-being.

It is interesting that anxiety is not associated with PTSD symptoms. According to prior studies that explored the relationship between depression and anxiety, anxiety could turn into depression (56). At the end of 2019, during a long period of isolation, anxiety stemming from COVID-19 information overload might turn into depression, and subsequently PTSD. However, in our findings, anxiety was not an influencing factor of PTSD.

This study has significant theoretical and practical implications. There are significant theoretical practical implications in this study. First, our findings are in accordance with the increasing number of studies and the recommendations of the WHO to reduce exposure to COVID-19-related information (10). Second, the linkage of PTSD and COVID-19 information overload has not yet been well examined. Therefore, the research is possibly the first empirical study to our knowledge that has examined them, which promotes the theoretical development of COVID-19 information overload. Third, the outcomes or consequences of COVID-19 information

TABLE 4 | Cronbach's α statistics, loadings of the study.

Study measures	Measurement items	Loading	Cronbach' α statistics
COVID-2019 Information overload (INF)	INF1	0.857	0.867
	1. In the last month, have you received so much information about the pandemic that it has "overwhelmed" you?		
	6. In the last month, have you feel stressed because you received a lot of information related to the pandemic from different sources in a short period of time?		
	7. In the last month, have you feel that the COVID-2019 information you received at once was more than you could handle?		
	INF2	0.765	
	2. In the last month, did you forget to reply to a very important message?		
	5. In the last month, do you have to spend more time maintaining your communication devices in order to receive information?		
	INF3	0.801	
	3. In the last month, have you felt that you have to constantly refresh of search COVID-2019 related information?		
Anxiety (ANX)	4. In the last month, did you receive more COVID-2019 information than you could handle?		0.922
	ANX1	0.923	
	4. Feeling it is hard to relax yourself		
	5. Unable to meditation due to restlessness		
	7. Feeling worried because something terrible seems to be going to happen		
	ANX2	0.863	
	2. Unable to stop worrying		
	3. Worrying too much about various things		
	ANX3	0.876	
Depression (DEP)	1. Feeling nervous or anxious		0.919
	6. Feeling easily annoyed or impatient		
	DEP1	0.836	
	1. Feeling unmotivated or uninterested in what you are doing in the last 2 weeks		
	2. Feeling down, frustrated or hopeless in the last 2 weeks		
	3. Difficulty in falling asleep, sleeping restlessly, or sleeping excessively		
	DEP2	0.922	
	4. Feeling fatigue in the last 2 weeks		
	5. You have lost your appetite or eaten too much in the last 2 weeks		
	6. You feel bad about yourself, or feel like a failure in the last 2 weeks		0.878
	DEP3		
	7. You have trouble focusing on things, such as reading the newspaper or watching TV in the last 2 weeks		
	8. People can notice that you are talking or moving significantly slower than before, or conversely, you seem more irritable than usual in the last 2 weeks		
	9. You sometimes think it's better to die or you have the thoughts to hurt yourself in the last 2 weeks		

(Continued)

TABLE 4 | Continued

Study measures	Measurement items	Loading	Cronbach' α statistics
PTSD	PTSD	0.986	0.947
	• Did the pandemic has brought back uncomfortable memories, thoughts or images to you repeatedly?		
	2. Did the pandemic caused you recurring nightmares?		
	3. Did you feel as if the pandemic has broken out again or gotten worse?		
	4. Did you feel restless if something remind you about the pandemic?		
	5. Did you feel somatic discomfort if something remind you about the pandemic?		
	PTSD	0.859	
	6. Did you try to avoid thinking of or talking past experience about the pandemic?		
	7. Did you try to avoid participating in the events that remind you about the pandemic?		
	8. Did you have trouble remembering important information about the pandemic?		
	9. Did you loss interest in things you used to enjoy?		
	10. Did you feel alienate from others?		
	11. Did you feel emotional numbness?		
	12. Did you feel uncertain about you future?		
	PTSD3	0.939	
	13. Did you have trouble to fall asleep, or easily to wake up?		
	14. Did you feel that you are more easily to lose your temper than before?		
	15. Did you have trouble to concentrate?		
	16. Did you are very alert?		
	17. Did you feel easily frightened?		

INF, COVID-2019 information overload.

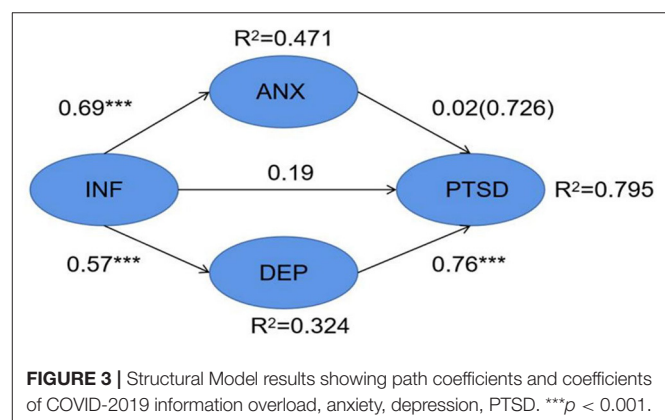
ANX, anxiety.

DEP, depression.

PTSD, post-traumatic stress disorder.

have been well investigated in relation to anxiety, depression, stress, information avoidance, etc. (6, 13); however, it is still unclear what are the further psychological outcomes. Minor psychological discomfort could develop severe mental disorders such as PTSD (57). This could be an opportunity for the development of future therapeutic interventions that could be delivered or partially delivered by mitigating COVID-19 information overload and, in return, alleviating the amplified negative outcomes among this population.

Our study has several practical implications. This study verified the relationship of PTSD, anxiety, depression and COVID-19 information overload. Hence, effective measures need to be adopted to reduce the extent of COVID-19 information overload if we want to reduce the incidence of anxiety, depression, PTSD or other negative outcomes (2). First, the chain linkage of COVID-19 information overload, depression, and PTSD suggested the significance of timely intervention at each point of mental state transformation. The mediating role of depression and PTSD could be a specific guideline for psychological intervention and prevention under



the context of COVID-19 infodemic. Second, our findings warrant policy makers that there is a need for public training to help them learn the criteria for determining the credibility of information on various platforms (2). Medium reliability (58),

TABLE 5 | Mediating effect, direct effect and total effect t.

Mediating effect	β	95%CI	P	B (standard)	95%CI (standard)
Ind1-anxiety	0.020	−0.143–0.168	0.810	0.012	
Ind2-depression	0.738	0.597–0.912	<0.001***	0.430	
Direct effect	0.325	0.211–0.464	<0.001***	0.190	0.122–0.268
Total effect	1.083	0.950–1.236	<0.001***	0.632	0.576–0.685

Ind1, the indirect effects of COVID-2019 information overload which mediated by anxiety.

Ind2, the indirect effects of COVID-2019 information overload which mediated by depression.

origin reliability (59), and message reliability (60), which are three proven influencing elements, are supposed to be involved in the training. Third, the findings reminded technology companies or other related stakeholders to manage the quality of COVID-19-related information, providing accurate and true information (10). Fourth, practical guidelines for individuals to cope with major crises are needed; otherwise, they might produce cognitive dysfunction, psychological disorders, and affective pressures (2).

This study has several limitations. First, this is a cross-sectional study that is unable to observe the transformation of depression into PTSD. Hence, further longitudinal studies and randomized controlled trials are needed to confirm the findings. Second, the measurements adopted in our study are brief screenings for depression, anxiety, and PTSD. Further clinical interviews and diagnoses are indispensable, as there is potential bias of self-rating scales. Third, the scales that measure the extent of COVID-19 information overload were developed and adopted in China, and the results might not be fully applicable to Western countries. Analysis of reliability and validity among different cultural contexts is warranted. Furthermore, the results of this study should also be tested in other countries.

CONCLUSION

The purpose of this study was to understand the short-term and long-term psychological outcomes of COVID-19 information overload during the pandemic in China. This study empirically explored the relationship between COVID-19 information overload, anxiety, depression, and PTSD. The findings of our study revealed a mediating role of depression in the process of COVID-19 information overload leading to PTSD. The positive association of COVID-19 information overload with anxiety and depression was also confirmed, suggesting the need for psychological interventions at specific times. Practical public training, such as crisis coping and information filtering, is essential. Regulation of technology companies is also essential.

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 authors.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of West China Hospital Sichuan University. 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

JW and XH involved in design of the study, acquisition of data, development of the statistical framework and reviewed the manuscript. MW and XL involved in the study design of and development analysis framework. JX and YW developed the statistical framework for data analysis, conducted the statistical analysis, interpreted the data and drafted the manuscript. All authors contributed to the article and approved the submitted version.

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Design for Pandemic Information: Examining the Effect of Graphs on Anxiety and Social Distancing Intentions in the COVID-19

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To increase public awareness and disseminate health information, the WHO and health departments worldwide have been visualizing the latest statistics on the spread of COVID-19 to increase awareness and thus reduce its spread. Within various sources, graphs are frequently used to illustrate COVID-19 datasets. Limited research has provided insights into the effect of different graphs on emotional stress and ineffective behavioral strategies from a cross-cultural perspective. The result of current research suggests a graph with a high proportion size of the colored area (e.g., stacked area graph) might increase people's anxiety and social distancing intentions; people in collectivist culture might have a high level of anxiety and social distancing intentions; the effect of different graphs on social distancing intentions is mediated by anxiety experienced. Theoretical contribution and practical implications on health communication were also discussed in this study.

Keywords: graph, culture, anxiety, social distancing, data visualization, COVID-19

INTRODUCTION

In January 2020, the World Health Organization (WHO) announced the outbreak of the new coronavirus disease COVID-19 as a public health emergency of international concern and that the risk of COVID-19 spreading worldwide was high (1–4). In March 2020, COVID-19 was further listed as a pandemic. Though the latest medical technology has dramatically promoted health conditions (1, 5), it is still necessary to increase public awareness and disseminate health information. Indeed, the WHO and health departments worldwide have been visualizing the latest statistics on the spread of COVID-19 to increase awareness and thus reduce its spread (6).

Individuals are exposed to information on COVID-19 daily through media such as newspapers, television, and the internet from sources such as the WHO Coronavirus Disease Dashboard (6), Worldometer dashboard (7), or Johns Hopkins Corona Virus Resource Center (8). Within various sources, graphs are frequently used to illustrate COVID-19 datasets. The more commonly used graphs are line, bar, and stacked area graphs (9). However, individuals experience mental stress when processing risk information (10). The difference in the presentation of charts or graphics affects individuals' perceptions and behavioral intentions (11). For example, research has suggested a positive relationship between seeking coronavirus updates and anxiety, common mental stress (12). However, limited research has provided insights into the effect of different

graphs on emotional reactions in the context of a pandemic. Considering that social distancing might play an indispensable role in controlling and suppressing the spread of COVID-19 (13), this study aims to investigate the effects of the most commonly used types of graphs (line graphs, bar graphs, and stacked area graphs) on individuals' mental health and preventive behaviors from a cross-cultural perspective.

BACKGROUND

Graphs in Data Visualization

In 1786, William Playfair first introduced graphs to visualize data (14). Since then, an increasing number of researchers have attempted to adopt this graphical representation tool and explore its potential advantages and disadvantages among different graphs (15). As a critical statistical representation tool, graphs have been used as a critical visual communication solution in various fields, such as science, technology, business, education, and mass media (16).

However, graph design guidelines and their effect on viewers have largely been neglected in the literature: individuals have generally relied on their intuition or common sense to make a “good” graph, although this is not always “scientific” (17). Indeed, graphs are more attractive than numbers because they are visually stimulating and can be perceived in a quick, automatic manner, despite some graphs required extra cognitive effort to make estimations (18). For example, the interpretation and calculation of particular graphics may depend on cognitive processing (19). Thus, an ideal graph should be designed to exploit visual heuristics while decreasing cognitive load (20).

Graphs are also widely adopted in printed and electronic materials among various health areas, such as risk assessment, risk signaling, and risk communication (18). However, scant literature has discussed how individuals interpret these public health graphs and how the associated perceptions raised. The understanding of graphs is usually different from what the designer planned. Accordingly, it might be both theoretically and practically significant to investigate the particular visual effects of public health communication on individuals' mental health and related behavior.

Graphs, Anxiety, and Social Distancing

We reviewed the daily COVID-19 updates from official resources, such as WHO, and observed different types of graphs. When visualizing COVID-19 updates, the most common information resources frequently use two types of graphs: thematic mapping and time series graph (6). For COVID-19 updates, a thematic map shows the spatial distribution of confirmed cases or deaths for selected geographic areas, and a time-series graph is used, for example, to visualize trends of total or daily confirmed cases or deaths over a period of time.

Within time-series graphs, there are three common graphs used to visualize COVID-19 updates: line, bar, and stacked area graphs (**Figure 1**). **Figure 1** illustrates trends of the global total of confirmed cases from Feb 1 to Jun 30, 2020: **Figure 1A** is a line graph that displays cases as a series of data points connected by straight line segments; **Figure 1B** is a bar graph that presents data

by using rectangular bars with heights or lengths proportional to the cases per day; **Figure 1C** is a stacked area graph that uses the area between the axis and a line to graphically display data.

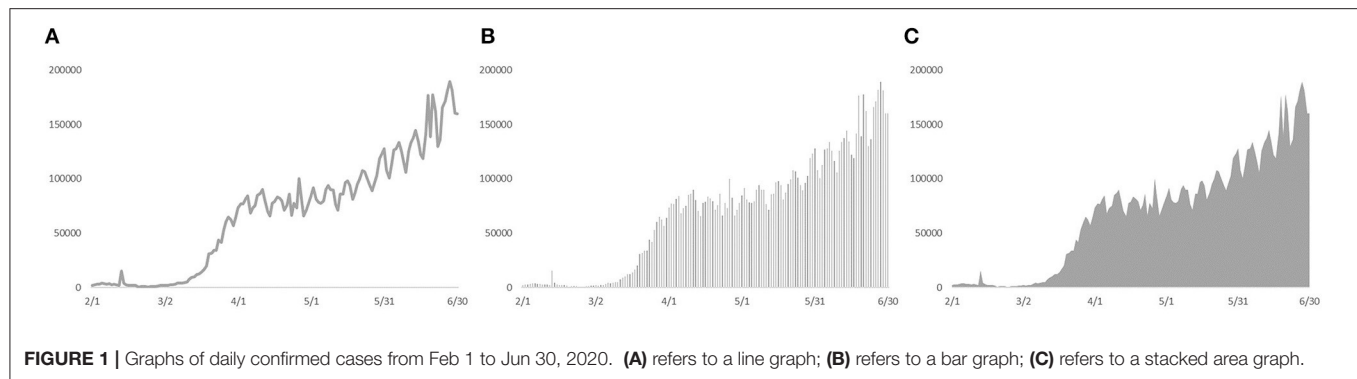
Visually, the most significant difference among these three graphs is the different portion sizes of foreground colored area on the background-colored area. In **Figure 1**, the foreground color of the stacked area graph is gray, and its background-color is white; thus, it has the highest portion size of the colored area, followed by the bar and line graphs. When individuals observe the health updates graph, its information could be perceived as threatening: dissemination of pandemic information might not only improve public awareness but also potentially dampen social wellbeing, such as people's anxiety about the crisis (21). The reason might lie in the bias in the embodied cognition where numerical estimation did not follow a linear relationship with spatial estimation (22). To specify, people tend to overestimate the associated number for high-intensive space while underestimating the number for low-intensive space (23). Thus, people would like to have a stronger sense and overestimate for a large area (24–26). Considering portion size has been demonstrated to have a significant positive impact on anxiety (27, 28), a reasonable prediction is that a graph with a large portion-size area, compared with a small area, could cause a higher level of anxiety in the context of COVID-19 updates.

In addition, many studies have shown that individuals' perceptions of risk and public awareness are positively correlated with higher intentions for ineffective behavioral strategies (5, 29, 30). Accordingly, anxiety might mediate the effect of different graphs on intentions for social distancing (31).

Cultural Difference in Anxiety and Social Distancing

The research has also suggested that the anxiety of specific populations may be affected by their personality traits, such as cultural elements. According to social identity theory, collectivist self-esteem refers to individuals' self-esteem in relation to the social network to which they belong, rather than respect for themselves (32). Specifically, collectivist self-esteem indicates the extent to which individuals evaluate social groups (33). Compared with individualistic cultures, such as the Caucasian culture in the United States (US), collectivist self-esteem plays a more significant role in collectivist cultures such as China (34). That is, individualistic cultures value the expression and proposition of individual desires, and collectivist cultures pay more attention to maintaining group harmony (34).

Collectivist self-esteem also has a significant impact on the mental health of individuals compared with individualistic cultural backgrounds (35). For example, residents of East Asian countries (36) and immigrants from East Asia to Western countries (37) tend to experience higher levels of social anxiety than individuals from individualistic cultures since collectivism requires people to feel their obligations and responsibilities to group members (38). When exposed to risk information, such as COVID-19 updates, collectivists have stronger emotional reactions and experience higher pressure than individualists (39, 40) because they might have a stronger intention to avoid the



risk and return to normal, maintaining group harmony (41). Therefore, an expectation is that in the context of visualizing COVID-19 updates, stacked area graphs might aggravate the anxiety perception by collectivist people (42). In other words, it might be that graph types and cultures could jointly influence anxiety perception and social distancing intentions.

STUDY HYPOTHESIS

Based on the literature shown above, hypotheses (H1a to H3b) are stated as follows:

H1a: A graph with a high (vs. low) proportion size of the colored area might result in a high (vs. low) level of anxiety.

H1b: Individuals in collectivist (vs. individualistic) cultures tend to experience a high (vs. low) level of anxiety.

H2a: A graph with a high (vs. low) proportion size of the colored area might have high (vs. low) social distancing intentions.

H2b: Individuals in collectivist (vs. individualistic) cultures tend to have high (vs. low) social distancing intentions.

H3a: Perceived anxiety mediates the effect of different graphs on social distancing intentions.

H3b: Perceived anxiety mediates the effect of different cultures on social distancing intentions.

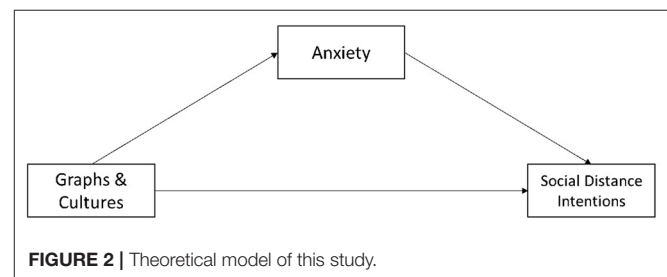
H4: Graph types and cultures jointly influence anxiety and social distancing intentions.

EXPERIMENT DESIGN

The experiment was designed to examine the main effect of different graphs and cultures on social distancing intentions and the mediating role of anxiety in this process (Figure 2).

Participants and Design

A three (different graphs: line graph, bar graph, and stacked area graph) by two (different cultures: individualism vs. collectivism) between-participants experiment was conducted. Specifically, participants in this experiment were from two sources: the Chinese sample and the US sample. The Chinese sample was recruited from Wenjuanxing (43), and the US sample was recruited from Amazon Mechanical Turk (AMT) (44). Both Wenjuanxing and AMT are crowdsourcing platforms to recruit



individuals and conduct behavioral research because of their adequate reliability and validity (16, 45, 46). We posit that both platforms are good data collection sources, especially considering their widely distributed population, which can avoid sampling bias to a large extent (16, 45, 46).

Stimuli/Material

This study was approved by the Ethical Committee of Shenzhen University (SZUDA20190901001). In the selection of an appropriate index to describe the trend of the COVID-19 crisis, total confirmed cases, daily confirmed cases, and deaths are the most common indicators (6). Nevertheless, these three indicators are of different magnitudes: total confirmed cases and deaths are cumulative time series data, and daily confirmed cases are daily time-series data, which vary frequently. On one hand, it might be inappropriate to introduce three indicators in one graph due to their significantly different magnitudes. On the other hand, total confirmed cases or deaths (total cumulative count) might focus more on the overall severity of the pandemic, while daily new cases might work as a more obvious indicator for trends and predictions regarding COVID-19 (47). Thus, we choose daily new cases as an indicator in this study. Because we investigated the role of cultural differences in response to different graphs, daily confirmed cases for the specific country might bias individuals' emotional status (48). Accordingly, we focused on the global COVID-19 daily new cases, rather than a particular country. To sum up, COVID-19 daily new cases (from Feb 1 to Jun 30, 2020) were extracted from the WHO data repository to illustrate the trends for COVID-19. Microsoft Excel, as one of the most data visualization tools, was used to visualize the COVID-19 data into three graphs (see Figure 1).

Measurement

As for measurements, since the graph of daily new cases is efficient to illustrate the latest trends of COVID-19, it might influence participants' current anxiety level and their anticipation of COVID-19. Thus, current anxiety level and anticipated anxiety level were measured separately by using the participants' responses to two items on a nine-point Likert scale (My current level of anxiety about COVID-19 is high; If I were to develop flu-like symptoms tomorrow, I would be anxious) (31). Since current anxiety level and anticipated anxiety level constituted the participants' overall anxiety level, overall anxiety was treated as the main factor and measured as the average of current anxiety and anticipated anxiety. In addition, social distancing intentions were measured with a single item (I will avoid going to crowded places in the next few days) on a nine-point rating scale (31). Cronbach's alphas of overall anxiety (0.73) were checked and achieved adequate reliability (49), suggesting it was appropriate for further analysis.

Sample Size Justification

Power analysis for ANOVA was performed to determine the sample size per group (50). Software G*Power was performed on the effect size of Cohen's $d = 0.40$ and results showed 30 participants per group in the current setting was adequate to attain 80% power (alpha was set at 0.05) (51). Thus, one hundred and eighty participants were recruited in the experiment (mean age = 33.43, SD = 10.47; 107 males and 73 females; 90 US participants and 90 Chinese participants; 14 participants with high school or below, 75 participants with some college, 91 participants with college graduate or above).

As for the analysis plan, the effect of cultures and graphs on current anxiety, anticipated anxiety, and overall anxiety was firstly explored with descriptive analysis, examining H1a and H1b. Then, the effect of cultures and graphs on social distancing intentions was further analyzed, testing H2a and H2b. In addition, the mediating analysis of anxiety in signaling social distancing intentions was conducted to confirm H3a and H3b. Further, to examine H4, we tested the interaction effect of cultures and graphs on anxiety and social distancing intentions. Last, a chi-square test was analyzed to investigate whether people would have a bias for different graphs. The significance level in the analysis was set at 0.05.

Procedure and Statistical Analysis

The procedure of this experiment involved four parts: pre-study, recruiting, introduction, and the main study. We initially recruited 60 participants *via* Wenjuanxing and conducted a pre-study to ensure the clarity and consistency of the questionnaires. The formal recruitment was followed up after confirmation of the appropriateness of the questionnaire design. Specifically, the experimental task was distributed *via* two channels: participants were recruited with the help of Wenjuanxing for collectivist culture and AMT for individualistic culture. After informing their unique ID will be recorded for research purposes, participants who consented to be enrolled in this study could click the checkbox, "I agree to participate in the research", and proceeded. For the main study, they were first asked to provide demographic information and were then randomly assigned to

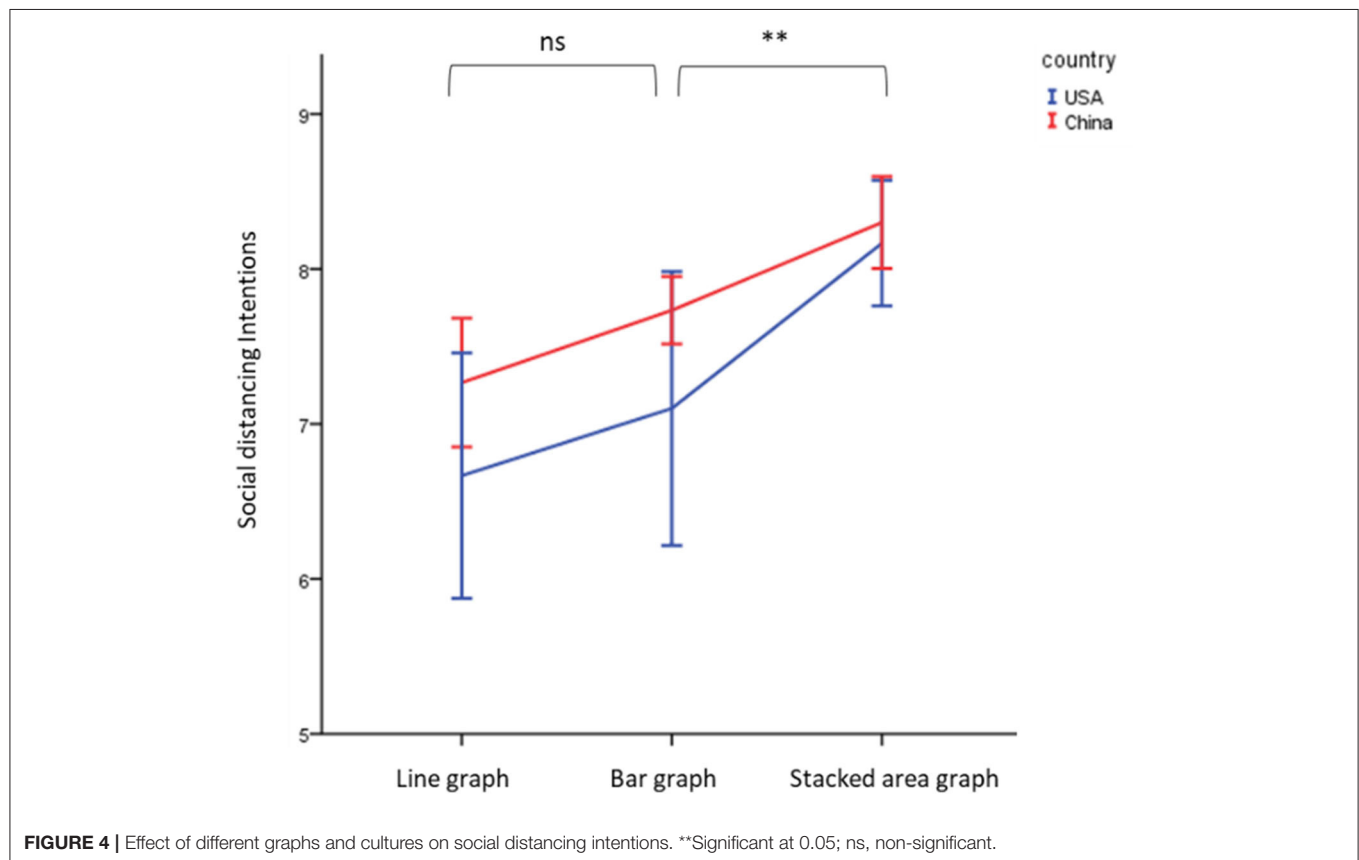
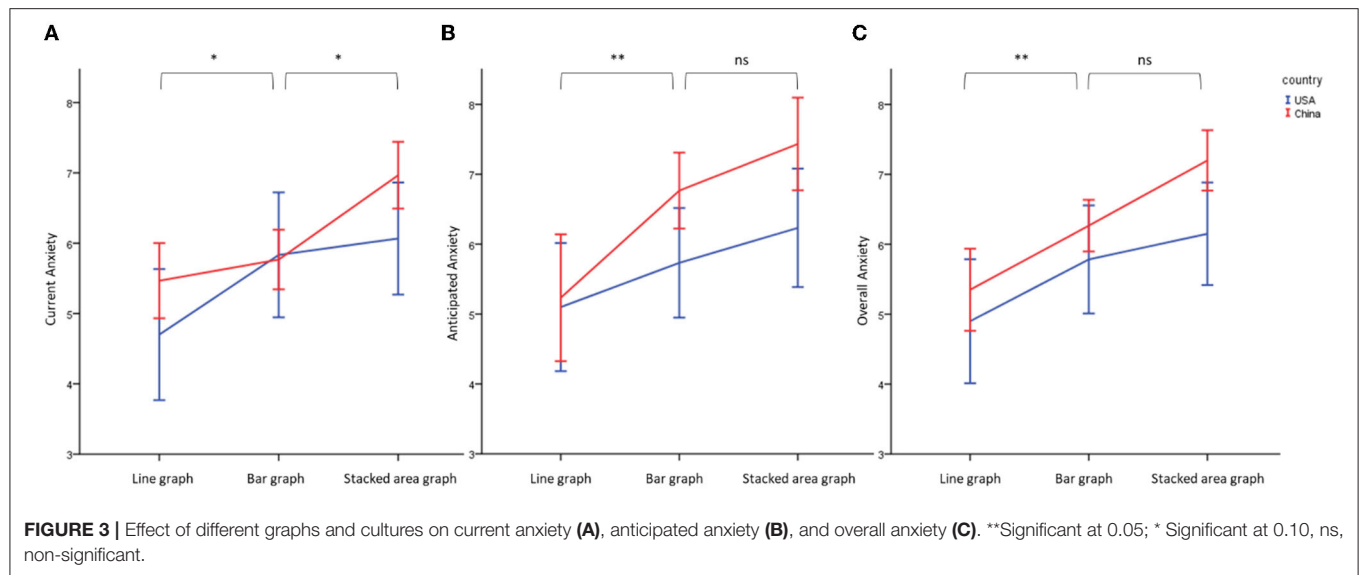
one of three stimuli (each graph was seen by 30 participants). Subsequently, they were asked to pay attention to the specific COVID-19 graph for 5 s (52), and then, were instructed to answer a set of questions for anxiety evaluation. Last, they were instructed to estimate the daily confirmed cases on Jun 30, 2020, from four choices (A. approximately 140,000 per day; B. approximately 150,000 per day; C. approximately 160,000 per day; D. approximately 170,000 per day). According to the data from the WHO, 159,962 individuals were confirmed on Jun 30. Thus, approximately 160,000 per day (C) was the correct choice. After finishing all the questions, they were informed they have finished the work. SPSS software was used to perform statistical analysis.

DATA ANALYSIS AND RESULTS

To test for H1a and H1b, a two-way ANOVA was conducted with different graphs (line graph, bar graph, and stacked area graph) and different cultures (individualism vs. collectivism) as the independent variables, and current anxiety, anticipated anxiety, and overall anxiety level as the dependent variables. Supporting H1a, the results showed the significant main effect of different graphs: individuals exposed to the stacked area graph had the highest level of current anxiety [Mean = 6.52, SD = 1.79; $F_{(2, 174)} = 8.64$, $p < 0.01$, Eta-squared = 0.09], anticipated anxiety [Mean = 6.83, SD = 2.10; $F_{(2, 174)} = 9.62$, $p < 0.01$, Eta-squared = 0.10], and overall anxiety [Mean = 6.68, SD = 1.68; $F_{(2, 174)} = 11.73$, $p < 0.01$, Eta-squared = 0.12]; the bar graph had a medium level of current anxiety (Mean = 5.80, SD = 1.84), anticipated anxiety (Mean = 6.25, SD = 1.86), and overall anxiety (Mean = 6.02, SD = 1.62); and the line graph had the lowest level of current anxiety (Mean = 5.08, SD = 2.05), anticipated anxiety (Mean = 5.17, SD = 2.42), and overall anxiety (Mean = 5.13, SD = 2.01). Further *post hoc* tests are illustrated in Figure 3.

Partially supporting H1b, the results also indicated the marginally significant main effect of culture (significant for the anticipated and overall anxiety while non-significant for the current anxiety): individuals in China have a higher level of current anxiety [Mean = 6.07 vs. 5.53, SD = 1.42 vs. 2.39; $F_{(1, 174)} = 3.59$, $p = 0.06$, Eta-squared = 0.02], anticipated anxiety [Mean = 6.48 vs. 5.69, SD = 2.12 vs. 2.30; $F_{(1, 174)} = 6.27$, $p = 0.01$, Eta-squared = 0.04], and overall anxiety [Mean = 6.27 vs. 5.61, SD = 1.46 vs. 2.18; $F_{(1, 174)} = 6.35$, $p = 0.01$, Eta-squared = 0.04] than US individuals. However, there is no significant interaction effects on current anxiety [$F_{(2, 174)} = 1.15$, $p = 0.31$], anticipated anxiety [$F_{(2, 174)} = 1.10$, $p = 0.33$], and overall anxiety [$F_{(2, 174)} = 0.55$, $p = 0.57$].

Similarly, the two-way ANOVA was also performed on social distancing intentions. The results showed that individuals exposed to the stacked area graph experienced a higher social distancing intentions [Mean = 8.23, SD = 0.94; $F_{(2, 174)} = 10.99$, $p < 0.01$, Eta-squared = 0.12] than for the bar graph (Mean = 7.42, SD = 1.74) and line graph (Mean = 6.97, SD = 1.70), and the difference in social distancing intentions between Chinese and US individuals were significant [Mean = 7.77 vs. 7.31, SD = 0.94 vs. 2.02; $F_{(1, 174)} = 4.15$, $p = 0.04$, Eta-squared = 0.02]. Thus, H2a and H2b was supported (Figure 4). However, there was no significant interaction effect between



different cultures and graphs [$F_{(2, 174)} = 0.52, p = 0.59$]. H4 was not supported.

To test H3a and H3b, the mediating role of anxiety and social distancing intentions were regressed on different graphs and cultures with overall anxiety as the mediator (model 4; $n = 5,000$ resamples; Hayes, 2015). According to the results, we observe a significant mediation effect for graphs ($\beta = 0.16, SE = 0.08, LLCI$

$= 0.02, ULCI = 0.20$) and cultures ($\beta = 0.17, SE = 0.09, LLCI = 0.03, ULCI = 0.37$), separately. Figures 5, 6 show the separate mediation analysis.

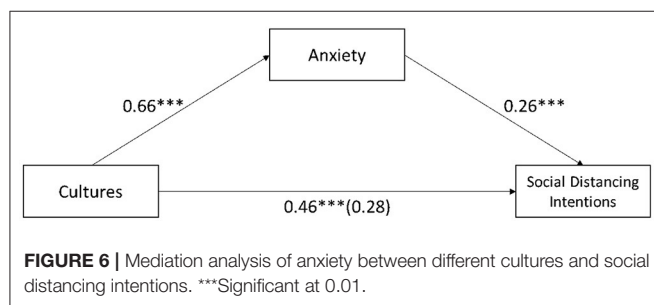
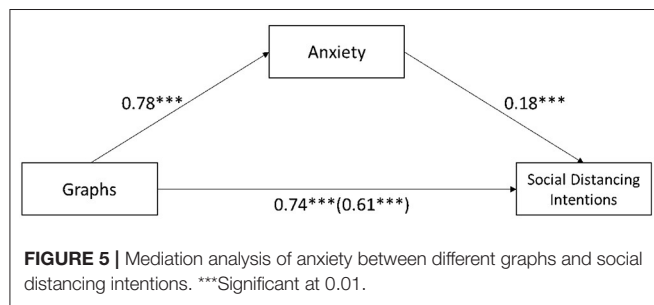
Last, for new case estimation, we observe that the participants in the stacked area graph tended to overestimate the daily cases (the most common response was option “D”), and individuals exposed to the line graph underestimated the daily cases (the

most common responses were options “A” and “B”). A chi-square test ($6, N = 180$) = 9.04, $p = 0.17$, showed no significant difference between different graphs and different options (Figure 7).

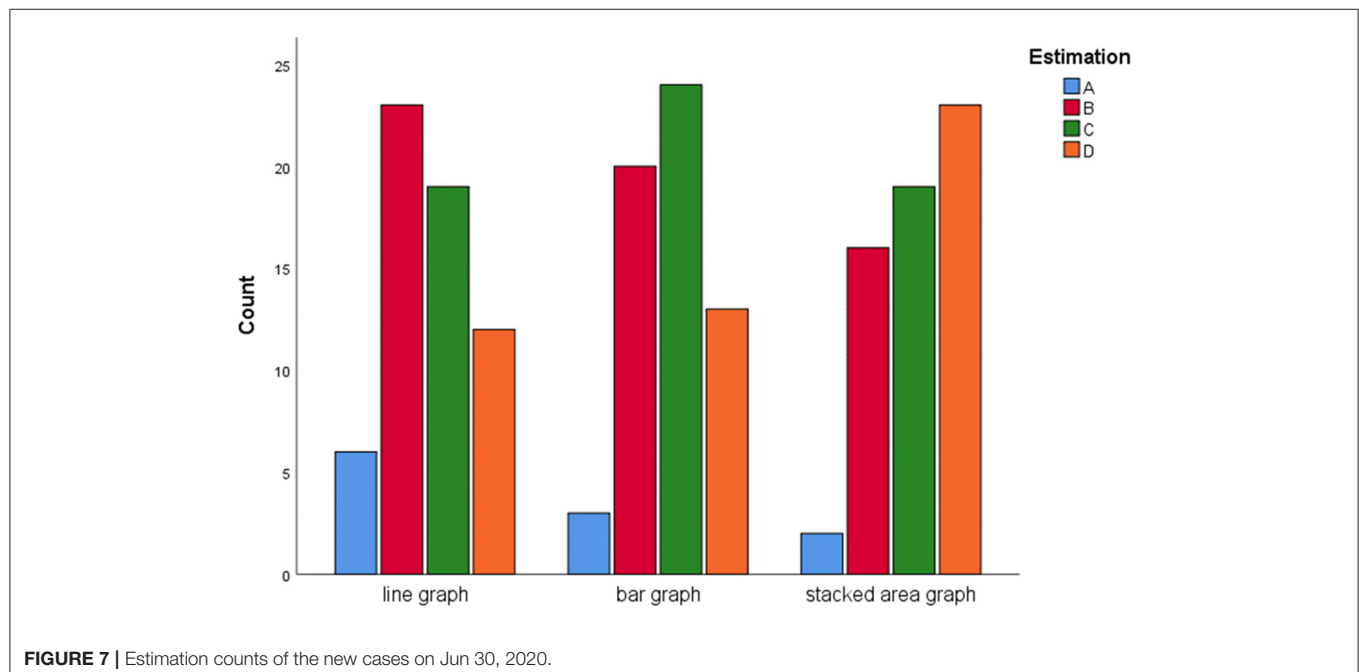
DISCUSSION

Theoretical and Practical Implications

This study mainly makes two theoretical contributions to the literature. To begin with, this study contributes to data



visualization theory in the context of COVID-19. The rapid speed of the information and communications technology evolution has fundamentally changed how individuals obtain the latest public health information (53). Indeed, an increasing number of individuals are searching for health-related information on the internet (54). Regarding the intuitive nature of the visual presentation, graphs on health information have been widely used (55). Research on health information visualization has mainly focused on two perspectives: the difference between graphs and numbers (e.g., a table), and different design features within one graph (e.g., the size of a graphic element) (18). Scant research has attempted to discuss the most common types of graphs and their impact on health information communication. Thus, it is theoretically significant to examine the relationship between different graphs and their influences on behavior or behavioral intentions. Consistent with the research on embodied cognition (23, 27, 28), the stacked area graph resulted in a higher level of anxiety and social distancing intentions, followed by the bar graph and line graph. Although a stacked area graph might work as a better visualization tool to improve public awareness, it still could increase people's anxiety and dampen social wellbeing. Accordingly, we might still face an ethical dilemma: stacked area graphs might help to communicate health information and decrease people's intentions to get crowded while it could also threaten some residents who have already experienced stress, anxiety, and even depression *via* various social media (56). Related authorities might need to strike a balance between increasing public awareness and its potential deficiency and implement necessary mental services, such as a hotline, to support public mental health, especially vulnerable people (57). Another intriguing thing is through a line graph might not promote public awareness and social distancing, individuals might still prefer and like it for its simplicity and familiarity (58).



In addition, the current study validates the finding that, compared with individualism cultures in Western countries, individuals living in collectivist cultures, such as that in China, might generally experience higher social anxiety (59). However, the cultural elements did not aggravate the anxiety perception and social distancing intentions for collectivists, namely, different cultures might similarly proportional influence the effect of graphs on anxiety perceptions. Moreover, regarding the effect size of cultures and graph types, results showed the effects of cultures on anxiety and social distancing intentions were relatively small (<0.06) while the effect of graph types was relatively medium (>0.06) (60). It might suggest that graph types might have a more significant impact on anxiety and social distancing, compared with different cultures.

As for social distancing intentions, we observed a significant difference between different cultures, which is consistent with previous research on cultural differences in social distancing: people from individualistic countries are less likely to commit the social distancing as the governmental suggestions (61). Accordingly, there seem tradeoffs between the degree of freedom and constraints from the various viewpoints across societies when committing social distancing (61).

This study also has the following managerial implications. First, because the outbreak of COVID-19 continues to pose significant challenges worldwide (6), it is critical to increase public awareness and encourage social distancing (62). Compared with line graphs and bar graphs, stacked area graphs might work as an efficient tool to increase public health awareness and social distancing toward the COVID-19 crisis, nevertheless, we cannot neglect its potential threats on social mental health and should further consider specific characteristics of the audience. For example, since the whole world is still currently within the COVID-19 pandemic, different countries or regions might face different outbreak stages of COVID-19. Thus, some people in a collectivist culture might generally experience a higher level of anxiety when exposed to the same health information. Considering striking a balance between public wellbeing and social distancing, it might be more appropriate to use different graphs for different residents based on their current situations.

Limitations and Further Research Directions

This study has limitations that require further investigations. First, although the line, bar, and stacked area graphs are the most common time-series graphs in communicating COVID-19 updates, there are other time-series graphs, such as scatter plots, which are seldom used for health risk communication (9). Thus, further research could comprehensively analyze different time series graphs' influence on public health awareness and risk-prevention behavior. In addition, the graphic proportion of different graphs is the main means for communicating risk-related information; however, there are many other design elements in graph design, such as color, font size, and animation, which might elicit public health awareness and social distancing (18). For example, the colors red and yellow could significantly elicit higher anxiety than the colors blue and green (63)

because higher levels of Chroma might increase greater feelings of excitement and more intense behavioral reactions (64). Regarding the WHO COVID-19 dashboard's general use of the colors gray or blue in visualizing data (6), the effect of graph color and its interaction with different graph types on public health awareness and social distancing requires further research to determine the most appropriate combinations of graph design elements. Further, though social distancing intentions could be influenced by social anxiety, they might also be shaped by various factors, such as local restrictions and governmental regulations (65) and resident characteristics (66). Thus, a possibility that different cities within one country might have different social distancing policies, such as the limitation of public gatherings to four persons in Hong Kong (67), which might elicit individuals' social distancing intentions to some extent (65). Last, for the measurements of anxiety, we used a single-item scale (or the average of two items) to assess the related anxiety level. Although a single-item scale might enjoy relatively similar reliability and validity compared with the multiple-item scale, the multiple-item scale indeed outperformed the single-item scale in specific cases (68). A further study should consider local regulations and examines their impact on people's social distancing intentions and applied a multiple-item measurement of related anxiety to validate the current finding.

CONCLUSION

Considering COVID-19 information visualization is widely used in various media communications of the latest health updates, this study examined the effect of different graphs and cultures on individuals' anxiety levels and social distancing intentions. Specifically, we indicated the mediation effect of anxiety on the relationship between different graphs and social distancing intentions and the role of different cultures in responding to different graphs. The results of this study demonstrate the following: (1) the stacked area graph caused the highest level of anxiety and social distancing intentions, followed by the bar and then line graphs; (2) Collectivist residents tended to experience a higher level of anxiety and social distancing intentions than individualistic residents; (3) there were no interaction effects of different graphs and cultures on anxiety level and social distancing intentions; (4) the effect of different graphs and cultures on social distancing intentions was mediated by anxiety level; (5) individuals exposed to the stacked area graph tended to overestimate the daily confirmed cases, and those exposed to the line graph tended to underestimate the daily confirmed cases.

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 Ethical Committee of Shenzhen University (SZUDA20190901001). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JL, YZ, and YS: conceptualization, methodology, and writing—original draft preparation. YS: formal analysis. YZ and JL: investigation. JL: resources. JL and YS: data curation. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpubh.2022.800789/full#supplementary-material>

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Association Between Social Support and Perceived Stress: A Cross-Sectional Study on Staffs of the Epidemic Prevention During the Covid-19 Epidemic in China

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Background: The Coronavirus Disease 2019 (COVID-19) lockdown considerably affects people's life in China, both physically and mentally. Staffs of the epidemic prevention and control in the community have played an irreplaceable role during community lockdown period in Wuhan. However, few studies have focused on their health status during epidemic prevention. This study aimed to appraise the available evidence of health conditions of them and explore the influencing factors.

Method: Used a multistage sampling method, we conducted a survey in staffs of the epidemic prevention and control in the community ($N = 503$). Descriptive analysis was used to characterize the respondents. *T*-test and analysis of variance were for group differences analysis. Confirmatory factor analysis (CFA) was used to verify the scale validity, correlation analysis and pathway analysis and Structural equation model (SEM) was used to study the relationship between stress perception, social support, mental resilience and sleep quality. Statistical analysis was performed with SPSS 26.0, R version 4.1.3 and Mplus 8.3.

Results: The mean Perceived Stress Scale (PSS) score of the respondents was 13.28 ± 7.31 and 51.1% had higher PSS score than the normal. In the absence of social support, people's sleeping quality and psychological resilience may decrease, their perceived stress may elevate and compromise mental health correspondingly. Social support could affect perceived stress directly, while Sleep quality and psychology resilience played significant partial mediating roles in social support affecting perceived stress. The mediating effects accounted for 50.8% of the total.

Conclusion: Staffs of the epidemic prevention and control in the community suffered from poor sleep quality and high level of stress perception. Establishment of good social support may effectively reduce their stress and this effect is mediated by sleep quality and psychological resilience. Physical health status would affect the staffs' mental health and they more attention should be paid to those with poor physical health.

Keywords: stress perception, social support, sleep quality, psychological resilience, COVID-19

INTRODUCTION

COVID-19 is highly transmissible, and community lockdown strategy can effectively limit community transmission of the virus (1). In order to stop the spread of the disease, major cities in Hubei implemented lockdown strategy from January 23 to April 8, 2020. During the lockdown period, intercity travel was banned and a cordon sanitaire of Wuhan and surrounding cities in Hubei Province was established. Besides, closure and containment directives from Government included school closure, workplace closure, public transport closure, public even cancellation, restrictions on gathering and stay at home requirements. Movement restriction required residents to stay at home, only one person per household was allowed to pick up online group shopping products in the community every 1–3 days and other family members were not allowed to go out under exceptional circumstances (such as: fever, acute illness) (2). During the community lockdown period, the daily management and service of community residents are mainly taken charge of by grassroots community anti-epidemic staffs, including medical and non-medical staffs. Non-medical staffs are composed of community workers, police and volunteers. The work of non-medical staffs mainly includes collecting basic information of residents, transferring patients, disinfecting the community, and providing daily necessities to residents who are isolated at home (Figure 1) (3, 4).

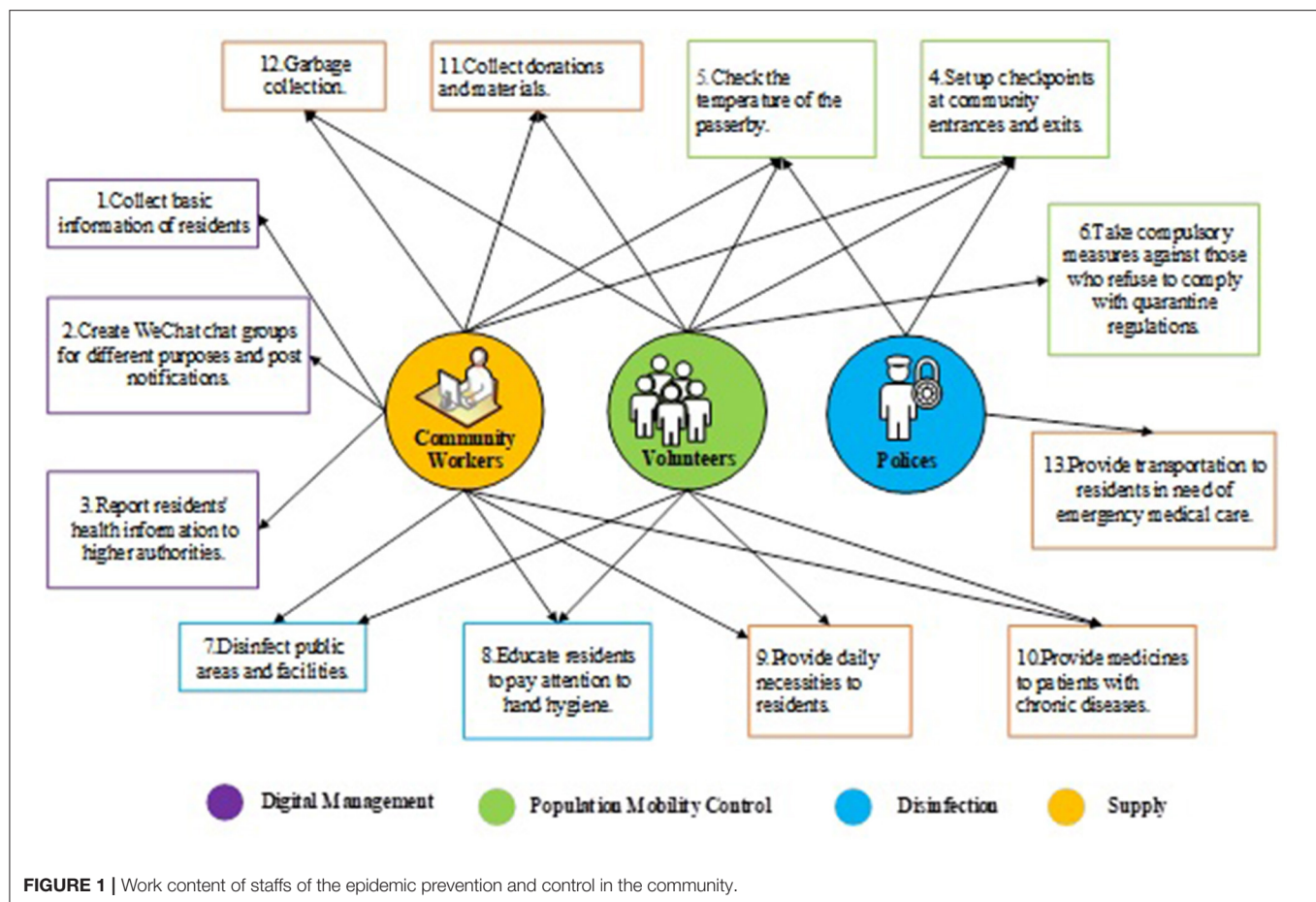
The spread of COVID-19 has been proved to trigger stress, anxiety, fear, helplessness, depression and then threaten their health (5, 6) and other psychological crises grow (7) in turn. In addition to targeting physical health, we should also pay attention to people's mental health. There have been some studies on people's mental health during the epidemic, yet most of them are focused on medical staff (8) or general residents (9). Though a myriad of prevention and control measures have been employed, conditions are still grim for some countries as the virus continues to mutate and spread. Community-based prevention and control has been proved to be the backbone of the anti-epidemic system and plays an important role in maintaining efficient medical order, screening suspected patients, preventing imported cases, ensuring material support, stabilizing public sentiment, reducing disease fear, and maintaining national security (10). During the lockdown period, the cumulative number of confirmed cases in Hubei rose from <400 to more than 60,000, putting great pressure on prevention. Faced with heavy work tasks and worried that going out will infect novel coronavirus, they may suffer greater psychological pressure (11, 12). Excessive psychological pressure often leads to mental health problems, such as depression, anxiety, insomnia and so on (13–15).

Stress is reflected in the long-term interaction between people and the environment and interacts with many variables and processes. Psychological stress occurs when a person feels that the demands of the environment exceed his ability to adapt. Stress is a complex process that is constantly changing (16, 17). Everyone has different feelings toward pressure, and pressure perception is used to evaluate individual's subjective feelings toward pressure, which is defined in this study as individual's cognition and evaluation of stimulus events. By evaluating the pressure caused

by stimulus events, individuals can feel whether it will threaten their internal balance. Regarding the measurement of stress, we use Perceived Stress Scale (PSS) to measure of the degree to which situations in one's life are appraised as stressful (18). Compared with pressure, pressure perception pays more attention to the individual's subjective feelings, and some scholars believe that pressure perception is more meaningful than pressure itself (19).

Previous studies have shown that there was insufficient social support and a run on medical resources in the early stage of COVID-19 epidemic, which brought great psychological pressure to the residents in Wuhan (20). The incidence of anxiety and depression of the public aged 18–76 were 26.83 and 33.46%, respectively. The average stress perception was (13.75 ± 5.22) points, which were at a moderate stress level (21). The level of stress perception of college students who study at home rose significantly during the lockdown period (22). The reported rates of stress, anxiety and depressive symptoms among medical staff in Wuhan Tongji Hospital were 29.8, 24.1, and 13.5%, respectively (23). It is not difficult to find that the currently available studies mainly focus on medical personnel and residents while few reports on non-medical staffs of the epidemic prevention and control in the community in Wuhan during the lockdown period. It is nevertheless also important to assess and protect the mental health of the staffs of the epidemic prevention and control in the community and free them from psychological problems. The study on the psychological status of 503 college students showed that there was a negative correlation between social support and perceived stress, and psychological resilience played a mediating role. Among males, the relationship between social support and perceived stress was almost entirely mediated by psychological resilience (24). A survey of 2806 college students showed that stress perception negatively predicted sleep quality, negative emotions played a partial mediating role, and social support had a moderating effect on this mediating effect (25).

Though there have been some studies on social support, stress perception, psychological resilience, and sleep quality, few explored the relationships among the four. COVID-19 has a high rate of mutation and the effects of COVID-19 are profound. Omicron variant (B.1.1.529) is extremely contagious and is raging in the world now. More and more staffs are involved in epidemic prevention. There is a critical need to ensure the physical and mental health of staffs of the epidemic prevention and control in the community as they are the backbone of combating spread. This study investigated the mental health conditions of non-medical staffs of the epidemic prevention and control in the community in Wuhan during the lockdown period, and explore the influencing factors, so as to provide a reliable basis for protecting their mental health. Based on the existing research, we put forward 3 research hypotheses: during the epidemic, (1) staffs of the epidemic prevention and control may suffer from poor mental health; (2) people's level of social support can affect their level of stress perception. (3) psychological resilience and sleep quality may play a mediating role in it. Our study may help to provide a scientific basis for psychological interventions and targeted training programs, so as to strengthen the mental health status in the face of the epidemic.



MATERIALS AND METHODS

Participants and Procedure

The survey was carried out in Wuhan, China from March 16th to 24th, 2020. Before the survey, the study design was reviewed by local ethical committee and the investigation was carried out in accordance with the latest version of the Declaration of Helsinki. We use a multistage sampling approach. According to the urban zoning, three urban areas are randomly selected from the seven central urban areas in Wuhan: Wuchang District, Jiang'an District and Hongshan District. There are 467 communities in the 3 districts selected and then, respectively chose 15 communities at random from each district. Staffs of the epidemic prevention and control in the community selected were randomly selected to conduct an anonymous questionnaire survey. The whole sampling process was completed step by step by the survey select process of SAS 9.4 software, strictly following the principle of randomness. Due to the standard of epidemic prevention, electronic questionnaire was used instead of paper questionnaire. Considering the response rate and questionnaire efficiency, the sample size was enlarged by 10%, and the expected sample size was 495. The Inclusion criteria for this study were as follows: (1) The respondent had at least 1 month of work experience in epidemic prevention. (2) The respondent had no

mental illness and had not been stimulated by adverse life events. (3) The respondent gave informed consent to this research and volunteered to participate. Exclusion criteria were as follows: (1) The respondent was older than 65. (2) The respondent was able to take shifts off.

A total of 503 questionnaires were sent out in this survey. After eliminating the ones with logic errors and those that did not meet the inclusion and exclusion criteria, 474 valid questionnaires were collected with a recovery rate of 94.23%.

Instrument and Measures

The questionnaire included five aspects: demographics, Perceived Stress Scale (PSS), Multidimensional Scale of Perceived Social Support (MSPSS), Pittsburgh Sleep Quality Index (PSQI) and 10-item Connor-Davidson Resilience Scale (CD-RISC-10).

Demographics

On the basis of literature review, the questionnaire was designed according to the purpose of the study. Before conducting a formal survey, we would fully explain the purpose, meaning and use of the questionnaire to obtain the informed consent of the participants. In this part, we investigated the respondents' sex, age, educational level, marital status, work experience, contact with patients with confirmed or suspected COVID-19, height and

TABLE 1 | Measures of PSS, MSPSS, PSQI, and CD-RISC-10.

Indicators	Scale	Mean	SD	Reliability of dimension (Cronbach's α)	Reliability (Cronbach's α)
Measures of perceived stress					
p1 felt upset because of something that happened unexpectedly	0–4	1.39	1.02	0.920	0.878
p2 felt unable to control the important things in life	0–4	1.16	1.04		
p3 felt nervous and stressed	0–4	1.27	1.06		
p6 felt hard to cope with all the things that you need to do	0–4	1.12	1.00		
p9 felt angered because of things that happened that were outside of your control	0–4	1.15	0.93		
p10 there were too many difficulties and you could not overcome them	0–4	1.03	0.96		
p4 felt confident about your ability to handle your personal problems	0–4	1.32	1.14		
p5 felt that things were going your way	0–4	1.80	1.08		
p7 you were able to control irritations in your life	0–4	1.49	1.17	0.834	
p8 felt that you were on top of things	0–4	1.54	1.16		
Measures of social support					
s1 There was a special person who was around when you were in need.	1–7	5.30	1.46	—	0.965
s2 There was a special person with whom you could share your joys and sorrows.	1–7	5.42	1.34		
s3 Your family really tried to help you.	1–7	5.85	1.30		
s4 You got the emotional help and support you needed from your family.	1–7	5.93	1.26		
s5 You had a special person who was a real source of comfort to you.	1–7	5.49	1.38		
s6 Your friends really tried to help you.	1–7	5.46	1.39		
s7 You could count on your friends when things went wrong.	1–7	5.27	1.47		
s8 You could talk about your problems with your family.	1–7	5.54	1.40		
s9 You had friends with whom you could share your joys and sorrows.	1–7	5.54	1.34		
s10 There was a special person in your life who cared about your feelings.	1–7	5.40	1.41		
s11 Your family was willing to help you make decisions.	1–7	5.68	1.35		
s12 You could talk about your problems with your friends.	1–7	5.34	1.39		
Measures of sleep quality					
A subjective sleep quality	0–3	1.03	0.79	—	0.821
B sleep latency	0–3	1.27	0.98		
C sleep duration	0–3	1.03	0.90		
D habitual sleep efficiency	0–3	0.68	0.96		
E sleep disturbance	0–3	0.81	0.67		
F use of sleep medication	0–3	0.05	0.33		
G daytime dysfunction	0–3	1.01	0.94		
Measures of psychological resilience					
r1 Able to adapt to change.	0–4	2.86	1.20	—	0.947
r2 Can deal with whatever comes.	0–4	2.97	1.09		
r3 Tries to see humorous side of problems.	0–4	3.23	0.92		
r4 Coping with stress can strengthen me.	0–4	3.22	0.98		
r5 Tend to bounce back after illness or hardship.	0–4	2.98	1.02		
r6 Can achieve goals despite obstacles.	0–4	3.07	1.03		
r7 Can stay focused under pressure.	0–4	3.04	0.98		
r8 Not easily discouraged by failure.	0–4	3.01	1.20		
r9 Thinks of self as strong person.	0–4	3.20	0.98		
r10 Can handle unpleasant feelings.	0–4	2.94	1.08		

TABLE 2 | Demographics of the respondents.

Characteristics	<i>n</i>	Mean ($\pm$ SD)	PSS	MSPSS	PSQI	CD-RISC-10
Age (18–65)	474	38.94 $\pm$ 10.18				
Hight (cm)	150–188	169.35 $\pm$ 7.18				
Weight (kg)	42–120	67.65 $\pm$ 13.68				
Gender						
Male	302		12.85 $\pm$ 7.45	66.98 $\pm$ 14.47	5.92 $\pm$ 4.21	31.45 $\pm$ 8.93
Female	172		14.02 $\pm$ 7.02	64.90 $\pm$ 12.96	5.79 $\pm$ 3.63	28.90 $\pm$ 7.69
Marital status						
Married	323		12.92 $\pm$ 7.18	67.22 $\pm$ 12.61	6.00 $\pm$ 3.88	30.51 $\pm$ 8.30
Unmarried	151		14.05 $\pm$ 7.55	64.09 $\pm$ 16.34	5.61 $\pm$ 4.27	30.55 $\pm$ 9.16
Education						
Middle school and below	19		15.21 $\pm$ 6.08	53.21 $\pm$ 23.18	4.95 $\pm$ 3.84	23.05 $\pm$ 13.17
Senior school	107		10.95 $\pm$ 7.29	67.25 $\pm$ 14.74	4.49 $\pm$ 3.85	31.93 $\pm$ 9.74
College and above	348		13.89 $\pm$ 7.24	66.62 $\pm$ 12.72	6.35 $\pm$ 3.96	30.56 $\pm$ 7.67
Job tenures						
<1year	51		11.94 $\pm$ 6.80	66.76 $\pm$ 14.15	5.51 $\pm$ 4.42	31.92 $\pm$ 8.01
1–3 years	112		13.41 $\pm$ 7.69	66.00 $\pm$ 15.26	5.67 $\pm$ 4.51	29.96 $\pm$ 9.67
4–6years	80		12.54 $\pm$ 7.13	64.65 $\pm$ 12.71	5.44 $\pm$ 3.65	30.46 $\pm$ 8.51
7–10years	63		12.81 $\pm$ 5.22	65.59 $\pm$ 13.91	4.79 $\pm$ 3.05	30.06 $\pm$ 7.12
>10years	168		14.13 $\pm$ 7.91	67.20 $\pm$ 13.67	6.73 $\pm$ 3.87	30.68 $\pm$ 8.54
Contact with individuals infected for suspected infected with COVID-19						
Yes	77		16.04 $\pm$ 8.00	65.40 $\pm$ 14.93	7.65 $\pm$ 4.40	30.26 $\pm$ 8.39
No	397		12.74 $\pm$ 7.06	66.38 $\pm$ 13.78	5.53 $\pm$ 3.88	30.57 $\pm$ 8.62
Prevalence of chronic disease						
Yes	124		14.64 $\pm$ 7.81	65.19 $\pm$ 13.82	7.69 $\pm$ 4.33	29.37 $\pm$ 8.47
No	350		12.80 $\pm$ 7.08	66.59 $\pm$ 14.02	5.23 $\pm$ 3.68	30.93 $\pm$ 8.59
Two-week prevalence						
Yes	140		15.72 $\pm$ 7.24	63.57 $\pm$ 13.31	8.10 $\pm$ 4.05	28.06 $\pm$ 8.32
No	334		12.25 $\pm$ 7.10	67.34 $\pm$ 14.10	4.94 $\pm$ 3.61	31.56 $\pm$ 8.48

Bold font indicates the presence of significant differences among groups ($p < 0.05$).

weight. Health-related factors include chronic disease and illness within 2 weeks. Chronic diseases require participants to answer “yes” or “no” to the following questions, “whether you currently diagnosed with the following diseases: diabetes, hypertension, heart disease, arthritis, migraine, asthma, thyroid disease, heart disease, thrombosis, bronchitis/emphysema, osteoporosis, cancer, stomach/peptic ulcer, cerebrovascular disease, or other major physical diseases; the illness within 2 weeks was defined as the prevalence of acute illness in the past 2 weeks.

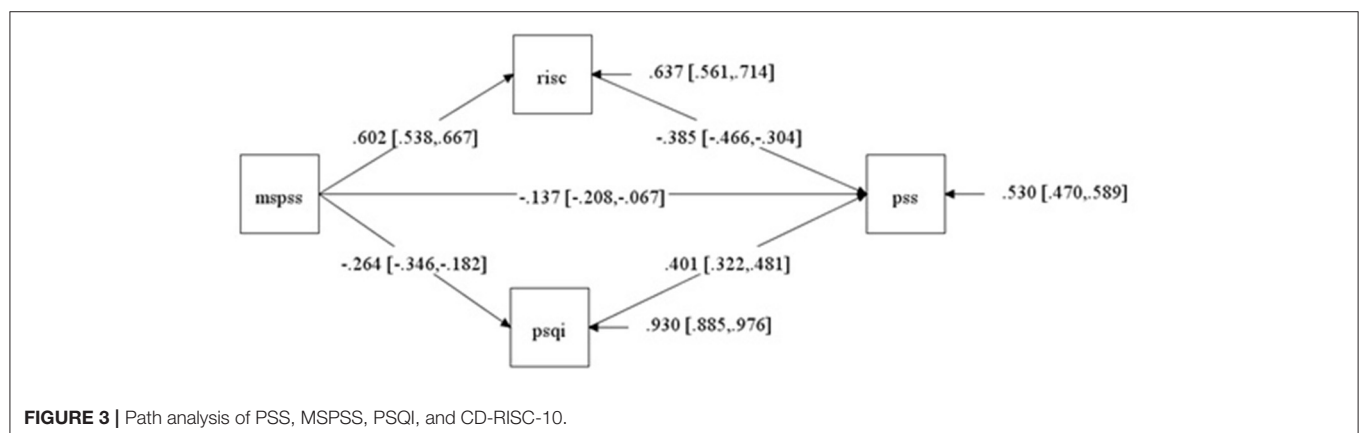
Perceived Stress Scale (PSS)

We use the Perceived Stress Scale (PSS) expressed on a 5-point Likert scale which asks respondents the frequency of occurrence of related situations in the past month developed by Cohen in 1983 to measure the degree of stress a person feels in his life (20). The frequency is expressed as never, almost never, sometimes, fairly often and very often are assigned 0–4 points, respectively. There are three versions of the scale, among which the simplified Chinese version of the 10-item scale has a moderate number of items, is widely used, and has been proved to have good reliability and validity in different populations (26, 27). Therefore, we

adopted the 10-item Perceived Stress Scale in this study. The 10 items are divided into two dimensions: tension (items: 1, 2, 3, 6, 9, 10) and sense of loss of control (items 4, 5, 7, 8, reverse scored) (28). The Cronbach's coefficient of the scale in this study is 0.878 (Table 1), which suggested a good reliability.

Multidimensional Scale of Perceived Social Support (MSPSS)

Social support refers to a series of support measures that a person receives through social relationships with other individuals, groups and community (11). We use the Multidimensional Scale of Perceived Social Support (MSPSS) expressed on a 7-point Likert scale developed by Zimet in 1988 to measure participants' social support (29). The scale consists of 12 items and higher scores indicating higher levels of social support. The accumulative score of each response was calculated as the total MSPSS score and a total MSPSS score <50 indicates a poor perceived social support (30). Studies have shown that the Chinese version of the scale has good reliability and validity (31). The Cronbach's coefficient of the scale in this study is 0.965 (Table 1), which suggested a good reliability.



Pittsburgh Sleep Quality Index (PSQI)

Sleep quality is a comprehensive evaluation index of sleep time, sleep speed, deep sleep degree and other factors. We use

Pittsburgh Sleep Quality Index (PSQI) developed by Buysse in 1989 to measure sleep quality (32). The PSQI scale consists of 19 items, which are divided into seven dimensions: subjective sleep

TABLE 3 | Path analysis of social support, stress perception, sleep quality, and psychological resilience of respondents.

Path	Direct effect	Indirect effect	Effect ratio
MSPSS → PSS	−0.137***		28.84%
MSPSS → CD-RISC	0.602***		
CD-RISC → PSS	−0.385***		
MSPSS → CD-RISC → PSS		−0.232***	48.84%
MSPSS → PSQI	−0.264***		
PSQI → PSS	0.401***		
MSPSS → PSQI → PSS		−0.106***	22.32%
Total effect		−0.475***	

*** $p < 0.001$.**TABLE 4 |** Goodness of fit of CFA and SEM.

Indicator	Criteria	CFA	SEM
χ^2	-	1093.852	1313.267
df	-	449	482
χ^2/df	<3	2.436	2.725
RMSEA	≤0.06	0.055	0.060
CFI	≥0.90	0.951	0.938
TLI	≥0.90	0.946	0.932

quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction. A higher score indicates poorer sleep quality. The Chinese version of the scale has good reliability and validity (33). The Cronbach's coefficient of the scale in this study is 0.821 (Table 1), which suggested a good reliability.

10-Item Connor-Davidson Resilience Scale (CD-RISC-10)

Werner defines resilience as “the ability of an individual to withstand high levels of disruptive change while displaying as few undesirable behaviors as possible (34).” 10-item Connor-Davidson Resilience Scale (CD-RISC-10), which was adapted by Campbell-Stills in 2007, was used to measure the psychological resilience of participants (35). The scale is expressed on a 5-point Likert scale and has a total of 10 items. Higher score indicates better psychological resilience (36). The Cronbach's coefficient of the scale in this study is 0.947 (Table 1), which suggested a good reliability.

Statistical Analysis

Descriptive analysis (means $\pm$ standard errors) was used to characterize the respondents. T -test and analysis of variance (ANOVA) were used for the group differences analysis. The above statistical analyses were performed using SPSS 26.0. Confirmatory factor analysis (CFA) was used to verify the validity of the scales, correlation analysis, pathway analysis and structural equation model (SEM) was used to study the relationship between different scales. The maximum likelihood estimation (ML) method was used to estimate the minimum

fitting criterion: $\chi^2/df < 3$, CFI ≥ 0.90 , TLI ≥ 0.90 , RMSEA ≤ 0.06 (37, 38). Mplus8.3 was used to conduct CFA, correlation analysis of latent variables, pathway analysis of scales (total score) and SEM. Pearson's correlation coefficient was calculated to test the statistical correlations between different scale (total score) via R version 4.1.3. The figures were developed using R version 4.1.3, Mplus8.3 and Office Visio 2018. $P < 0.05$ meant the difference was statistically significant. All statistical tests were two-tailed.

Quality Control

In this study, the questionnaire was adapted from four standard scales that have been proved to have good reliability and validity and was conducted through consulting a large number of literatures and repeated revision after expert consultation. The unified instruction at the beginning of the questionnaire explains the purpose of the study and the notes for filling in to prevent bias. All the items are set as compulsory questions, and the missing items are automatically detected to ensure the integrity of the questionnaire. Recycled data is checked and sorted by three or more people.

RESULTS

Demographic Characteristics of the Respondents

The results of quantitative descriptive analysis show that 63.7% of the respondents in this study were male. Most respondents were middle-aged (38.94 ± 10.18), married (68.1%) and had worked for more than 4 years (65.6%). The majority of the respondents had attained tertiary education (73.4%) while 4.0% only attained junior high school education or below. Results of univariate analysis illustrated that there were significant differences ($p < 0.05$) between scores of PSS and PSQI of respondents who had contacted with individuals infected or suspected infected with COVID-19 (PSS = 16.04 ± 8.00 , PSQI = 7.65 ± 4.40 , respectively) and those had not (PSS = 12.74 ± 7.06 , PSQI = 5.53 ± 3.88 , respectively). Respondents with chronic disease had higher scores of PSS (14.64 ± 7.81) and PSQI (7.69 ± 4.33) than those who were not (PSS = 12.80 ± 7.08 , PSQI = 5.23 ± 3.68 , respectively) ($p < 0.05$). Scores of all four scales of respondents who reported illness during the last 2 weeks before surveyed (PSS = 15.72 ± 7.24 , MSPSS = 63.57 ± 13.31 , PSQI = 8.10 ± 4.05 , CD-RISC-10 = 28.06 ± 8.32 , respectively) were higher than those who did not ($p < 0.05$). Differences in scores of CD-RISC-10 were found between sexes. Female got lower score of CD-RISC-10 (28.90 ± 7.69) than male (31.45 ± 8.93). Refer to Table 2 for more information.

Status of Individuals During the Epidemic

PSS, MSPSS, PSQI and CD-RISC-10 were applied to measure the status of individuals' perceived stress, social support, sleep quality and psychological resilience, and the mean scores were 13.28 ± 7.31 , 66.22 ± 13.97 , 5.87 ± 4.01 , 30.52 ± 8.58 , respectively. The mean PSS score of the respondents was higher than the normal level and 51.1% had a PSS score > 13 , suggesting a high level of people's perceived stress during the epidemic, which may lead to some psychological problems. 46.2% respondents

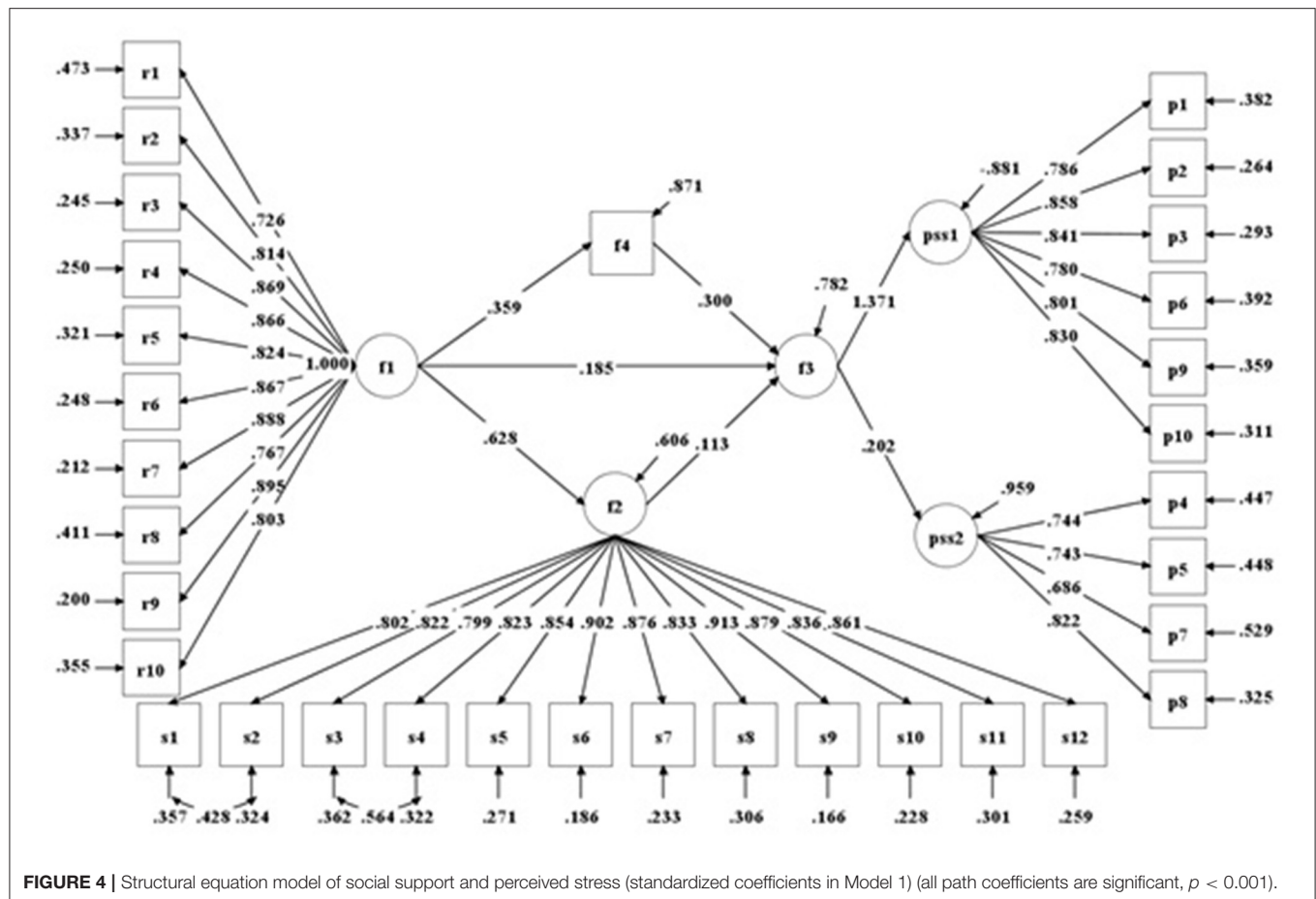


FIGURE 4 | Structural equation model of social support and perceived stress (standardized coefficients in Model 1) (all path coefficients are significant, $p < 0.001$).

had a PSQI score > 5 , indicating poor status of sleep quality. 16.2% respondents reported a poor perceived social support. We further compared the conditions of perceived stress and social support in different populations. Results from independent sample t -test illustrated that the conditions of social support and perceived stress in better-educated staffs (staffs who had acquired tertiary education) was better than that of better-educated (staffs who had not acquired tertiary education). Staffs who had been confirmed or suspected to be infected with COVID-19 were in worse status of social support and perceived stress than staffs who were not. Moreover, our results revealed that marriage showed a protective effect on staffs' social support and perceived stress.

Correlation analysis and pathway analysis were conducted to explore the relationship between different scales. Result of correlation analysis showed that there were significant correlations (Figure 2) between MSPSS, CD-RISC-10, PSQI and PSS ($p < 0.001$). MSPSS was positively correlated with CD-RISC-10 ($r = 0.602$, $p < 0.001$), while negatively correlated with PSQI ($r = -0.264$, $p < 0.001$) and PSS ($r = -0.464$, $p < 0.001$). PSQI and PSS were negatively correlated with CD-RISC-10 ($r = -0.316$, $p < 0.001$; $r = -0.581$, $p < 0.001$). PSQI was positively correlated with PSS ($r = 0.546$, $p < 0.001$). Based on the correlation analysis results, we conducted a path analysis and similar relationships

between each scale were obtained. Besides, significant mediations of CD-RISC-10 and PSQI in MSPSS affecting PSS were found (Figure 3). The indirect effects of CD-RISC-10 and PSQI were -0.232 ($p < 0.001$) and -0.106 ($p < 0.001$), accounting for 48.84 and 22.32% of the total effect, respectively (Table 3).

Goodness of Fit of CFA and SEM

The confirmatory factor analysis (CFA) was applied to assess the construct validity of the scale. Significant correlations of latent variables were observed through CFA ($p < 0.001$). Social support was positively correlated with psychological resilience ($r = 0.623$, $p < 0.001$) and perceived stress ($r = 0.816$, $p < 0.001$). Psychological resilience was positively correlated with perceived stress ($r = 0.639$, $p < 0.001$).

The structural equation modeling (SEM) was used to provide an interpretative modeling structure that accounted for the multivariate relationships between variables in the models. In order to make the results easier for readers to understand, measurement of sleep quality was back-transformed for presentation and the calculation formula was as follows: $sleep < uscore > quality = 21 - PSQI$. Higher score indicated better sleep quality. Two models were performed (Model 1 & Model 2) to examine the effect of social support on perceived stress and the mediating effects of psychological resilience and

sleep quality. Based on Model 1, a chained mediating model was applied in Model 2: social support $\rightarrow$ sleep quality $\rightarrow$ psychological resilience $\rightarrow$ perceived stress. In the mediating analysis, bootstrap method (bootstrap = 500) was used. Results of Model2 showed that the chain mediation effect did not exist, so we chose the results of Model1 as the final model. The fit statistics showed a good model fit (Table 4).

The Mediating Role of Psychological Resilience and Sleep Quality in Social Support Affecting Perceived Stress

Model 1 was ultimately selected as the best model. Figure 4 shows the standardized path coefficients of direct and mediating effects in Model 1. As expected from the results, there were direct positive relationships between the respondents' perceived stress and their social support ($b = -0.179, p < 0.001$), psychological resilience ($b = -0.119, p < 0.001$) as well as their sleep quality ($b = -0.304, p < 0.001$) significantly. The respondents' social support was positively correlated with their psychological resilience ($b = 0.634, p < 0.001$) and sleep quality ($b = 0.363, p < 0.001$). Both psychological resilience and sleep quality played a partial mediating role in social support affecting perceived stress. The overall proportion explained by the mediating effect of psychological resilience and sleep quality was 50.8% (20.6 and 30.2%, respectively). The mediating effect of sleep quality ($b = 0.110, p < 0.001$) was stronger than that of psychological resilience ($b = 0.075, p < 0.001$).

DISCUSSION

Based on a multistage sampling cross-sectional study conducted from March 16 to March 24, 2020, we appraised the available evidence of health conditions of community epidemic prevention staffs in Wuhan and explored the influencing factors. Similar to previous studies (39), we found that non-medical community epidemic prevention staffs were in poor conditions of psychological status and sleep quality. It was observed that most respondents (51.1%) had high level of perceived stress, 16.2% respondents perceived a poor social support and 46.2% had poor quality of sleep during the epidemic prevention of COVID-19. Differences in four scales surveyed between male and female were not found expect for CD-RISC-10 in the presented study. Female showed weaker psychological resilience than male. Physical health status would affect the staffs' mental health. Specifically, respondents with chronic disease or respondents who had contacted with individuals infected or suspected infected with COVID-19 perceived higher stress and had worse quality of sleep than those not. Respondents who reported illness during the last 2 weeks before surveyed perceived higher stress, lower level of perceived social support, worse quality of sleep and weaker psychological resilience. It was also found that elevated social support would help reduce perceived stress of staffs of the epidemic prevention and control in the community, and both psychological resilience and sleep quality played important mediating roles in the process of social support affecting perceived stress.

Community lockdown during the epidemic is a very common measure, we should pay attention to people's health conditions not only the isolated people but also the executors'. The staffs of the epidemic prevention and control are important personnel on the front lines in their departments and perhaps experience more safety problems and suffer from more stress. As the front line of epidemic prevention and control, non-medical community epidemic prevention staffs bore more risk and greater stress during the epidemic and were more likely to suffer from anxiety and depression than medical staffs (39). Attention should be paid to their mental health. Although as a special professional group, they have experienced psychological training, high-intensity continuous work and strong psychological load under the background of sudden epidemic will still bring them greater problems physically and mentally.

According to our study, more scientific and targeted management measures should be taken by relevant management department to tackle the unsatisfying mental health conditions and sleep quality of the community epidemic prevention and control staffs in the battle against COVID-19, so that they can carry out the front-line epidemic prevention work with better physical and mental state. Measures such as reasonably organizing their working hours and ensuring adequate sleep can be taken to reduce their perceived stress. An approach to obtain the optimal peak load shifting plan is probably justified. The COVID-19 pandemic could to some extent be termed as a loneliness pandemic for it requires maintaining social distance, which inhibits the development of social interaction. We need to consider some ways to keep pace with practice to improve the level of social support, for example, provide timely psychological comfort and psychological guidance for them, especially for female and staffs with poor physical health.

Though our study offers a novel angle to reduce people's perceived stress, this study may have the following limitations. On the one hand, we only use social support at the self-perception level, and there is no sufficient evidence to test the probable influence mechanisms of actual social support on perceived stress. The measurement of social support is subjective, and it is influenced by individuals' psychological state. The scale with objective social support index can be used in later research, such as the Social Support Questionnaire (SSQ) and the Interview Schedule for Social Interaction (ISSI) (40). On the other hand, when examining the mediating variables of psychological resilience and sleep quality, we actually set perceived stress as the terminal of causal path, which is based on the previous studies, but they may have a causal relationship with each other, which is subject to the inherent limitations of cross-sectional data, which needs to be further tested by tracking data.

CONCLUSION

In addition to opportunistic infections, staffs of the epidemic prevention and control in the community suffered from poor sleep quality and high level of perceived stress. Establishment

of good social support may help improve sleep quality, elevate personal psychological resilience and decrease perceived stress. Social support may effectively affect their stress and this effect is mediated by sleep quality and psychological resilience. Physical health status would affect the staffs' mental health and they more attention should be paid to those with poor physical 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 Ethics Committee of Wuhan University. Written informed consent for participation was not required for this

study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

LZ: data analysis, writing—original and revised draft, and methodology. BF: data collation and writing—original draft. YX: data collection, data management, and preparation. QZ: data collection, data management, and preparation. SP: conceptualization, data curation, writing—review and editing, and validation. XT: conceptualization, data curation, writing—review and editing, validation, and supervision. All authors contributed to the article and approved the submitted version.

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Age, Motivation, and Emotion Regulation Skills Predict Treatment Outcome in an Internet-Based Self-Help Intervention for COVID-19 Related Psychological Distress

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Introduction: First evidence suggests that internet-based self-help interventions effectively reduce COVID-19 related psychological distress. However, it is yet unclear which participant characteristics are associated with better treatment outcomes. Therefore, we conducted secondary analyses on data from a randomized controlled trial investigating the efficacy of a 3-week internet-based self-help intervention for COVID-19 related psychological distress. In this exploratory analysis, we examined several predictors ranging from sociodemographic variables to psychological distress, resource-related, and treatment-related variables. This includes, for example, age, motivation, and emotion regulation skills. Treatment outcomes were defined as post-treatment depressive symptoms and post-treatment resilience.

Methods: In a total of 107 participants with at least mild depressive symptoms, possible predictor variables and treatment outcomes were assessed using self-report measures. For example, emotion regulation skills were assessed by the Self-report measure for the assessment of emotion regulation skills. In a first step, we performed a separate linear regression analysis for each potential predictor. In a second step, predictors meeting a significant threshold of $p < 0.05$ were entered in linear multiple regression models. Baseline scores of the respective outcome measure were controlled for.

Results: The mean age of the participants was 40.36 years ($SD = 14.59$, range = 18–81 years) with the majority being female ($n = 87$, 81.3%). Younger age predicted lower post-treatment depressive symptoms. Additionally, higher motivation to use the intervention and better pre-treatment emotion regulation skills predicted higher post-treatment resilience.

Conclusion: The current study provides preliminary evidence regarding the relationship between participant characteristics and treatment outcome in internet-based self-help interventions for COVID-19 related distress. Our results suggest that under the circumstances surrounding COVID-19 such interventions might be particularly beneficial for young adults regarding depressive symptoms. Moreover, focusing on participants' existing strengths might be a promising approach to promote resilience through

internet-based self-help interventions. However, since this was an exploratory analysis in an uncontrolled setting, further studies are needed to draw firm conclusions about the relationship of participant characteristics and treatment outcome in internet-based self-help interventions for COVID-19 related psychological distress.

Keywords: COVID-19, internet-based self-help, depressive symptoms (DSs), psychological distress, resilience

INTRODUCTION

In March 2020, the World Health Organization (WHO) declared the COVID-19 (acute respiratory syndrome coronavirus 2; SARS-CoV-2) outbreak a pandemic (1). At the onset and during the COVID-19 pandemic, studies indicated a deterioration of mental health in the general population (2–6). In particular, evidence for an increase in depression and anxiety symptoms was found (7). For example, in a study in the USA, a tripling of the prevalence of depression symptoms in the general population during the COVID-19 pandemic was reported (8). However, some studies reported that the COVID-19 pandemic and associated restrictions had no impact or even a positive impact on the wellbeing of the general population (9, 10). For example, Aghababa et al. (10) found stable activity patterns among team sport athletes and Albrecht et al. (9) report positive effects of homeschooling on adolescent sleep schedules. Moreover, some studies indicated that the initial increase in psychological distress in the general population decreased over the course of the COVID-19 pandemic (11–13). These findings suggest that on average, the general population might be resilient. Resilience can be defined as the maintenance of stable mental health or recovery from initial psychological distress in the face of major life stressors (14). Nonetheless, a substantial minority of the general population shows heightened psychological distress (15, 16). Accordingly, mental health interventions mitigating this psychological distress are needed.

A promising approach is the use of internet-based self-help interventions since they do not require direct on-site contact and are easily scalable (17–19). Studies indicate that internet-based self-help interventions are an effective treatment option for various psychological problems, including depressive symptoms (20, 21). So far, few studies have investigated the efficacy of internet-based self-help interventions for COVID-19 related psychological distress in the general population. However, first results suggest that internet-based self-help interventions are efficacious in reducing COVID-19 related worry and associated symptoms (22), symptoms of depression, anxiety, and stress (23, 24), as well as in promoting resilience and emotion regulation skills (25). Nonetheless, in one study, there was no significant reduction of depressive symptoms (25). Given that there is still comparatively little research on internet-based self-help interventions for COVID-19 related psychological distress and that it shows mixed results, it is important to find out who might benefit from internet-based self-help for COVID-19 related psychological distress.

In the context of the COVID-19 pandemic, understanding the relationship between participant characteristics and treatment outcome is of particular interest since some studies point toward the need for tailoring interventions for specific risk populations (5, 7). Identifying predictors of treatment outcomes in internet-based self-help for COVID-19 related psychological distress would allow interventions to be tailored to specific needs and thus improve intervention efficacy. Accordingly, knowledge of the predictors of treatment outcomes would inform how interventions could be improved for specific use in target populations or adapted for other target populations. For example, if age predicts treatment outcomes, interventions could be tailored and improved for specific age groups or adapted for those not yet reached. So far, potential risk factors for heightened psychological distress due to the COVID-19 pandemic include for example: pre-existing mental health problems (26–28), pre-existing physical health problems (27), younger age (29–32), identifying as non-binary (27), female gender (27–30), and difficulties in emotion regulation (33, 34).

However, no study to date has investigated predictors of treatment outcome in internet-based self-help interventions for COVID-19 related psychological distress. Therefore, to improve the understanding of the relationship between participant characteristics and treatment outcome in internet-based self-help for COVID-19 related psychological distress, we explored predictors of treatment outcome in an internet-based self-help intervention for COVID-19 related psychological distress called ROCO (25, 35). ROCO is an acronym for *Resilience and Optimism during COVID-19*. The 3-week ROCO intervention included guidance on demand and the participants had the possibility to contact a psychologist *via* a chat function. The efficacy of the ROCO intervention was evaluated in a randomized controlled trial, from which the data used in this study are drawn (25). The primary target of the ROCO intervention was a reduction of depressive symptoms. However, a considerable part of the intervention was also aimed at promoting resilience (35). Therefore, in the present study, we defined treatment outcomes as post-treatment depressive symptoms and post-treatment resilience. In the RCT, the 3-week ROCO intervention did not significantly reduce primary depressive symptoms and secondary outcomes such as anxiety and stress symptoms. Moreover, the intervention had no beneficial effects on secondary outcomes such as quality of life, optimism, embitterment, loneliness, and self-efficacy. However, the intervention led to a significant increase in emotion regulation skills and resilience (small-to-medium effect sizes).

The aim of this exploratory analysis is to investigate possible predictors of treatment outcome in an internet-based self-help intervention for COVID-19 related psychological distress. Specifically, we aimed to explore, who improves more during treatment. Based on the above mentioned previous research on possible risk factors for COVID-19 related psychological distress, we decided to explore sociodemographic variables (age, gender, and level of education), psychological distress variables (ever having received a psychiatric diagnosis, previous or current psychotherapy, current medication, anxiety, stress, embitterment, loneliness, and mental and physical health quality), and resource-related variables (emotion regulation skills, optimism, and self-efficacy) as possible predictors. Moreover, we explored if treatment-related variables (motivation to use the self-help intervention, number of completed modules) predict treatment outcome.

MATERIALS AND METHODS

Study Design

The data used in the current study were obtained in a parallel-group randomized controlled trial (RCT) investigating the efficacy of a short internet-based self-help intervention for COVID-19 related psychological distress called ROCO. The protocol of the study was approved by the Ethics Committee of the Canton of Bern, and the trial was registered on ClinicalTrials.gov (NCT04380909).

In the RCT, an immediate treatment group was compared to a waiting control group, with both groups receiving care as usual [CAU; (25, 35)]. Participants were randomized in a 1:1 ratio to either the immediate treatment group or the waiting control group. Participants in the immediate treatment group received direct access to the 3-week internet-based ROCO intervention, whereas participants in the waiting control group had a waiting period of 3 weeks and then received access to the ROCO intervention (i.e., delayed treatment). Three weeks after randomization, all participants had to fill out a second assessment (post-treatment for the immediate treatment group; pre-treatment for the waiting control group). All participants had to complete a third assessment 6 weeks after the randomization (follow-up for the immediate treatment group; post-treatment for the waiting control group). In the RCT, analyses were conducted according to an intention-to-treat principle (25).

For the present secondary analysis, data from both groups were combined, using the data of the respective treatment phase (immediate or delayed). The investigated predictors of post-treatment outcomes (depressive symptoms and resilience, respectively) were assessed before the respective treatment phase (i.e., for the immediate treatment group at baseline and for the waiting control group after the waiting period). Sociodemographic variables as well as information on previous or current psychological treatments (ever received a psychiatric diagnosis, prior experience with psychotherapy, current psychotherapy, or medication intake) were collected for both groups at baseline.

Participants

We recruited German-speaking participants between April 2020 and February 2021, primarily through newspaper articles, internet forums on mental health, and advertisements on the internet. Interested participants registered on our study homepage and subsequently received the detailed study information. After providing informed consent, participants completed the online baseline assessment, consisting of questions concerning socio-demographic variables, previous or current psychological treatment, and various self-report questionnaires.

The following inclusion and exclusion criteria were evaluated based on this baseline assessment: participants had to be at least 18 years of age, have access to the internet, show sufficient knowledge of the German language, provide an emergency address for the case of an acute crisis, and reach a minimum of 4 points on the Patient Health Questionnaire [PHQ; (36)], which is interpreted as the presence of mild depressive symptoms. Participants were excluded if they reached a cut-off value of 8 points on the Suicide Behavior Questionnaire [SBQ-R; (37)], which would indicate the presence of suicidal tendencies. Furthermore, participants reporting a known psychotic or bipolar disorder diagnosis were also excluded. A total of 107 participants met all the inclusion criteria and none of the exclusion criteria, thus constituting the current study sample.

Measures

All assessments were administered online and consisted of self-report questionnaires. We used the German versions of the self-report questionnaires.

Outcome Measures

Depressive symptoms, the primary treatment target of the internet-based intervention, were measured with the PHQ-9 (36). The PHQ-9 is used to assess the severity of depressive symptoms. For this purpose, nine items are scored on a scale from 0 = not at all to 5 = nearly every day. The items are introduced as follows: "Over the last 2 weeks, how often have you been bothered by any of the following problems?" Examples of items are: "Little interest or pleasure in doing things" and "Feeling down, depressed, or hopeless." The nine items correspond to the nine DSM-IV criteria for depression. From the nine items, a score is built: a score of 5 corresponds to mild depression, a score of 10 to moderate depression, a score of 15 to moderately severe depression, and a score of 20 to severe depression (38). In the present sample, the PHQ-9 had a satisfactory internal consistency (Cronbach's $\alpha = 0.72$ at pre-treatment and Cronbach's $\alpha = 0.74$ at post-treatment).

A secondary treatment target of the internet-based intervention was to promote resilience. Resilience was measured with the Connor-Davidson Resilience Scale [CD-RISC; (39)]. In the present study, the 10-item version of the CD-RISC was used. Examples of items are: "I am able to adapt to change" and "I can handle unpleasant feelings." The 10 items are answered on a scale from 0 = not true at all to 4 = true nearly all of the time. Higher scores correspond to more resilience. In the present sample, the CD-RISC showed good internal consistency

TABLE 1 | Predictors and outcome measures at baseline or pre-treatment, overall and divided by group.

	Total N = 107	Immediate treatment group n = 53	Delayed treatment group n = 54	Statistic
Socio-demographic variables				
Age, <i>M</i> (<i>SD</i>)	40.36 (14.59)	40.68 (15.55)	40.04 (13.73)	$t_{(105)} = 0.227, p = 0.819^b$
Female, <i>n</i> (%)	87 (81.3)	46 (86.8)	41 (75.9)	$\chi^2_{(1)} = 2.078, p = 0.149$
University, <i>n</i> (%)	64 (59.8)	26 (49.1)	38 (70.4)	$\chi^2_{(1)} = 5.055, p = 0.025$
Psychological distress variables				
Psychiatric diagnosis, <i>n</i> (%)	36 (33.6)	21 (39.6)	15 (27.8)	$\chi^2_{(1)} = 1.681, p = 0.195$
Psychological treatment				
Previous, <i>n</i> (%)	68 (63.6)	38 (71.7)	30 (55.6)	$\chi^2_{(1)} = 3.009, p = 0.083$
Current, <i>n</i> (%)	28 (26.2)	14 (26.4)	14 (25.9)	$\chi^2_{(1)} = 0.003, p = 0.954$
Current medication, <i>n</i> (%)	24 (22.4) $n^a = 105$	14 (26.4) $n = 52$	10 (18.5) $n = 53$	$\chi^2_{(1)} = 0.966, p = 0.326$
Anxiety (DASS-21), <i>M</i> (<i>SD</i>)	4.33 (3.26) $n = 105$	4.43 (3.51)	4.23 (3.01) $n = 52$	$t_{(101.3)} = 0.319, p = 0.741^b$
Stress (DASS-21), <i>M</i> (<i>SD</i>)	8.80 (4.10) $n = 105$	9.42 (4.03)	8.17 (4.12) $n = 52$	$t_{(103)} = 1.562, p = 0.119^b$
Embitterment (BEI), <i>M</i> (<i>SD</i>)	9.12 (5.04) $n = 103$	8.75 (4.88)	9.50 (5.22) $n = 50$	$t_{(101)} = -0.749, p = 0.440^b$
Loneliness (ULS), <i>M</i> (<i>SD</i>)	20.77 (4.46) $n = 105$	21.26 (4.82)	20.27 (4.04) $n = 52$	$t_{(100.6)} = 1.147, p = 0.261^b$
Mental health quality (SF-12), <i>M</i> , (<i>SD</i>)	31.66 (9.12) $n = 105$	31.10 (9.10)	32.23 (9.20) $n = 52$	$t_{(103)} = -0.636, p = 0.528^b$
Physical health quality (SF-12), <i>M</i> (<i>SD</i>)	53.65 (7.68) $n = 105$	53.43 (8.79)	53.87 (6.43) $n = 52$	$t_{(95.3)} = -0.292, p = 0.779^b$
Resources				
Optimism (LOT-R), <i>M</i> (<i>SD</i>)	14.33 (4.89) $n = 103$	14.43 (5.04)	14.22 (4.73) $n = 50$	$t_{(101)} = 0.222, p = 0.820^b$
Self-efficacy (GSE), <i>M</i> (<i>SD</i>)	26.29 (4.47) $n = 104$	25.91 (4.47)	26.69 (4.47) $n = 51$	$t_{(102)} = -0.890, p = 0.369^b$
Emotion regulation skills (SEK-27), <i>M</i> (<i>SD</i>)	62.70 (15.97) $n = 103$	62.64 (15.45)	62.76 (16.65) $n = 50$	$t_{(101)} = -0.037, p = 0.976^b$
Treatment-related variables				
Number of completed modules, <i>M</i> (<i>SD</i>)	3.51 (2.47)	4.15 (2.27)	2.89 (2.53)	$t_{(104.1)} = 2.719, p = 0.009^b$
Motivation, <i>M</i> (<i>SD</i>)	84.26 (14.14)	83.09 (17.20)	85.41 (10.35)	$t_{(85.0)} = -0.841, p = 0.417^b$
Outcome measures				
Depressive symptoms (PHQ-9), <i>M</i> (<i>SD</i>)	10.37 (4.18) $n = 105$	11.13 (4.36)	9.60 (3.89) $n = 52$	$t_{(102.1)} = 1.908, p = 0.055^b$
Resilience (CD-RISC), <i>M</i> (<i>SD</i>)	22.47 (6.68) $n = 103$	21.87 (6.62)	23.10 (6.75) $n = 50$	$t_{(101)} = -0.935, p = 0.359^b$

M, Mean; *SD*, standard deviation; DASS-21, Depression Anxiety Stress Scale; BEI, Bern Embitterment Inventory; ULS, UCLA Loneliness Scale; SF-12, Short-Form Health Survey; LOT-R, Life Orientation Test Revised; GSE, General Self-Efficacy Scale; SEK-27, Self-report Measure to Measure Emotion Regulation Skills; PHQ-9, Patient Health Questionnaire; CD-RISC, Connor-Davidson Resilience Scale.

^a*N*'s range from 103 to 107 due to occasional missing data. If *n* is not reported, it equals the number in the column header.

^bBootstrap 1,000 samples.

(Cronbach's $\alpha = 0.88$ at pre-treatment and Cronbach's $\alpha = 0.90$ at post-treatment).

Predictors

We grouped a total of 18 possible predictor variables into four groups: sociodemographic, psychological distress, resource-related, and treatment-related variables.

Sociodemographic Variables. We assessed *age*, *gender*, and *level of education*.

Psychological Distress Variables

At baseline, we assessed whether participants had *ever received a psychiatric diagnosis*, had *previously been in psychotherapy*, were

currently in psychotherapy, and were *currently taking medication for mental health problems*. These variables were chosen as measures of pre-existing mental health problems and current psychological treatment needs, indicative of psychological burden (13, 26).

At pre-treatment, we assessed several variables using self-report questionnaires. *Anxiety* and *stress* were measured by the corresponding subscales of the DASS-21 (40). Each subscale consists of seven items, which are answered on a scale from 0 = did not apply to me at all to 3 = applied to me very much or most of the time. Examples of items are: "I found it hard to wind down," "I felt I was close to panic," and "I was unable to become enthusiastic about anything." On the anxiety subscale, a

TABLE 2 | Single-predictor linear regression analysis with post-treatment depressive symptoms respectively post-treatment resilience as dependent variable controlling for pre-treatment depressive symptoms, respectively pre-treatment resilience.

Predictors	Depressive symptoms (PHQ-9)			Resilience (CD-RSIC)		
	ΔR^2	β	p	ΔR^2	β	p
Socio-demographic variables						
Age	0.066	0.259	0.006	0.004	0.066	0.382
Female Gender	0.019	-0.138	0.145	0.009	0.096	0.207
University	0.022	0.148	0.119	0.002	0.043	0.571
Psychological distress variables						
Anxiety (DASS-21)	0.044	0.246	0.026	0.000	0.005	0.950
Stress (DASS-21)	0.036	0.238	0.044	0.000	0.018	0.821
Embitterment (BEI)	0.001	0.030	0.767	0.011	0.113	0.158
Loneliness (ULS)	0.006	0.083	0.422	0.009	0.102	0.200
Mental health quality (SF-12)	0.000	0.012	0.925	0.000	0.021	0.794
Physical health quality (SF-12)	0.031	-0.178	0.063	0.001	-0.026	0.737
Psychiatric diagnosis	0.056	-0.237	0.011	0.000	0.002	0.982
Previous psychotherapy	0.069	-0.263	0.005	0.005	0.070	0.353
Current psychotherapy	0.063	-0.251	0.007	0.007	0.086	0.254
Current medication	0.005	-0.070	0.475	0.002	-0.045	0.573
Resources						
Self-efficacy (GSE)	0.011	-0.114	0.276	0.007	0.139	0.267
Optimism (LOT-R)	0.010	-0.103	0.302	0.000	0.008	0.934
Emotion regulation skills (SEK-27)	0.008	-0.103	0.349	0.024	0.189	0.037
Treatment-related variables						
Number of completed modules	0.026	-0.162	0.086	0.003	0.054	0.475
Motivation	0.020	0.141	0.135	0.027	0.163	0.030

Block one: pre-treatment depressive symptoms ($R^2 = 0.297$, $\beta = 0.545$, $p < 0.001$), respectively pre-treatment resilience ($R^2 = 0.580$, $\beta = 0.762$, $p < 0.001$). Block two: predictor variables. PHQ-9, Patient Health Questionnaire; CD-RISC, Connor-Davidson Resilience Scale; DASS-21, Depression Anxiety Stress Scale; BEI, Bern Embitterment Inventory; ULS, UCLA Loneliness Scale; SF-12, Short-Form Health Survey; GSE, General Self-Efficacy Scale; LOT-R, Life Orientation Test Revised; SEK-27, Self-report Measure to measure emotion regulation skills.

score of 4 represents mild anxiety, a score of 6 moderate anxiety, a score of 8 severe anxiety, and a score of 10 extremely severe anxiety. On the stress subscale, a score of 8 represents mild stress, a score of 10 moderate stress, a score of 13 severe stress, and a score of 17 extremely severe (41). In the present sample, the internal consistency at pre-treatment was close to satisfactory for the anxiety subscale (Cronbach's $\alpha = 0.68$) and good for the stress subscale (Cronbach's $\alpha = 0.81$).

Mental health quality and physical health quality were assessed as measures of general health-related quality of life with the respective scales of the 12-Item Short-Form Health Survey (27, 42). An example of an item is: In general, would you say your health is: Excellent, Very Good, Good, Fair, or Poor. Higher scores on the respective subscale indicate better mental health quality, respectively physical health quality. The SF-12 has a good test-retest reliability (43).

Embitterment was measured with the 6-item version of the Bern Embitterment Inventory (44). Embitterment can be defined as the feeling of being disadvantaged by others and fate and might be a mental health reaction to the COVID-19 pandemic (45–47). Examples of items are: “It fills me with bitterness when I think of the goals that have not been achieved” and “I sometimes think that all people are bad and corrupt.” Items are scored on a

scale from 0 = I do not agree to 4 = I agree, with higher scores representing more embitterment (48). In the present sample, the internal consistency of the BEI at pre-treatment was good (Cronbach's $\alpha = 0.80$).

Loneliness was assessed using the 9-item version of the UCLA Loneliness Scale [ULS; (49)] since several studies postulated a link between loneliness and mental health problems and the COVID-19 pandemic has been reported to increase loneliness (50, 51). Examples of items are: “How often do you feel that there are people you can talk to?” and “How often do you feel isolated from others?” The items are answered on a scale from 1 = never to 4 = often, with higher scores indicating more loneliness. In the present sample, the internal consistency of the ULS at pre-treatment was good (Cronbach's $\alpha = 0.85$).

Resource-Related Variables

We assessed several resource-related variables using self-report questionnaires at pre-treatment. *Self-efficacy* Was assessed using the General Self-Efficacy Scale [GSE; (52)]. The 10 items Are scored on a scale From 1 = Not at all true to 4 = exactly true, With higher scores indicating more self-efficacy (52). Examples of items Are: “It Is easy for me to stick to my aims and accomplish my goals” and “I can solve most problems if I invest the necessary

TABLE 3 | Predictors of the post-treatment depressive symptoms (multiple regression).

Predictors	Depressive symptoms		
	<i>b</i> (SE)	<i>t</i>	<i>p</i>
Pre-treatment depressive symptoms	0.299 (0.094)	3.193	0.002
Age	0.043 (0.020)	2.184	0.032
Anxiety (DASS-21)	0.179 (0.114)	1.565	0.122
Stress (DASS-21)	0.188 (0.096)	1.971	0.053
Psychiatric diagnosis	−0.763 (0.704)	−1.084	0.282
Previous psychotherapy	−1.313 (0.726)	−1.808	0.075
Current psychotherapy	−0.864 (0.768)	−1.125	0.264

The model was significant ($F_{(7,73)} = 10.715$, $p < 0.001$), adjusted $R^2 = 0.459$; the model includes an intercept ($b = 10.304$, $SE = 0.62$, $t = 16.650$, $p < 0.001$); predictors were selected based on single-predictor regressions (Table 2); predictors were grand-mean centered to avoid multicollinearity.

TABLE 4 | Predictors of the post-treatment resilience (multiple regression).

Predictors	Resilience		
	<i>b</i> (SE)	<i>t</i>	<i>p</i>
Pre-treatment resilience	0.691 (0.086)	8.007	<0.001
Group (immediate vs. delayed treatment)	−2.465 (0.917)	−2.687	0.009
Emotion regulation skills (SEK-27)	0.072 (0.036)	2.023	0.047
Motivation	0.092 (0.032)	2.851	0.006

The model was significant ($F_{(4,71)} = 35.858$, $p < 0.001$), adjusted $R^2 = 0.650$; the model includes an intercept ($b = 23.790$, $SE = 0.61$, $t = 38.857$, $p < 0.001$); predictors were selected based on single-predictor regressions (Table 2); predictors were grand-mean centered to avoid multicollinearity.

effort.” In the present sample, the internal consistency of the GSE at pre-treatment was good (Cronbach's $\alpha = 0.89$).

Optimism was assessed with the Life Orientation Test Revised [LOT-R; (53)]. The total score of the 10-item LOT-R is built from six items, since four items are filler items. A higher score indicates more optimism. Examples of items are: “In uncertain times, I usually expect the best” and “I rarely count on good things happening to me.” The items are answered on a scale from 0 = strongly disagree to 4 = strongly agree (53). In the present sample, the internal consistency of the LOT-R at pre-treatment was good (Cronbach's $\alpha = 0.84$).

Emotion regulation skills were assessed with the Self-report measure for the assessment of emotion regulation skills [SEK-27; (54)]. The 27 items of the SEK-27 are answered on a scale from 0 = never to 4 = (almost) always, with higher scores corresponding to better emotion regulation skills (54). The items are introduced as follows: “Dealing with emotions: Last week....” Examples of items then are: “I understood my emotional reactions,” “I was OK with my feelings, even if they were negative,” and “I supported myself in emotional distressing situations.” In the present sample, the internal consistency for the SEK-27 at pre-treatment was excellent (Cronbach's $\alpha = 0.93$).

Treatment-Related Variables

Motivation to use the internet-based intervention was assessed at baseline with one item (Please indicate your motivation to

use the ROCO program in general). Participants could rate their motivation with a regulator From 0 = no motivation at all to 100 = greatest possible motivation.

The *number of completed modules* was measured after the treatment. It could range from 0 (no module completed) to 6 (all modules completed).

Description of Intervention

The internet-based self-help intervention ROCO was aimed at persons experiencing COVID-19 related psychological distress. The 3-week intervention consisted of six thematic modules, an introduction, and a conclusion. Additionally, the intervention comprised a page with information on what to do in an acute crisis, including a list of emergency contacts, a page with an overview of the weekly exercises, and a page with a symptom-tracking questionnaire, allowing participants to track their self-reported symptoms. The six thematic modules were based on cognitive-behavioral therapy and included texts, videos, graphics, and exercises. Each thematic module had a specific focus: in module 1, psychoeducation about COVID-19 related psychological distress was given. In module 2, participants learned about emotions and emotion regulation. In module 3, the identification and restructuring of thought patterns were addressed. In module 4, participants acquired knowledge about several possibilities to promote resilience. In module 5, relaxation techniques and sleep hygiene were discussed. Finally, in module 6, the topics of self-care and personal growth were approached. For a more detailed description of the intervention, see the study protocol of the ROCO RCT (35). Participants were advised to work through two modules per week. However, the participants could decide for themselves which modules they wanted to work on and in which order. A module took about 40 to 80 mins to complete. Since the internet-based self-help program offered guidance on demand, the participants had the possibility to contact a psychologist *via* a chat function. The psychologist answered within three working days. Otherwise, there was no scheduled contact.

Statistical Analysis

All analyses were conducted using IBM SPSS Statistics (version 25). Independent samples *t*-tests and χ^2 -tests (for nominal data) were performed to examine group differences at baseline and pre-treatment. In a first step, potential predictors were identified using simple linear regression analyses. For each potential predictor a separate linear regression analysis was performed as follows: the potential predictor (e.g., age) was entered as predictor, the post-treatment score of the outcome (depressive symptoms or resilience) was entered as dependent variable, and the pre-treatment score of the respective outcome (e.g., depressive symptoms) was defined as covariate. We predetermined, that predictors had to reach a *p*-value below 0.05 to be included in the subsequent multiple regression analyses. In a second step, a multiple regression analysis was performed for each outcome with the predictors identified in step 1 entered as predictors and the pre-treatment score of the respective outcome entered as covariate. All tests were two-sided. This approach of stepwise selection of predictors has been

criticized (e.g., for leading to bias in predictor effects or variability of selected predictors) and modern prediction methods have been recommended (55, 56). Accordingly, stepwise regression procedures are unfavorable for explanatory purposes. However, since stepwise regression procedures might be of value for exploratory data analysis (57), we refrained from using modern prediction methods.

To account for possible group effects, we additionally tested whether group (immediate vs. delayed treatment) was a significant predictor for the outcome while using the pre-treatment values of the respective outcome as covariate. If the group was a significant predictor ($p < 0.050$), it was added as covariate in the multiple regression analysis of the respective outcome. We did not replace missing data in the predictor variables. Hence only participants with complete data sets were considered for the respective outcomes (completers analysis).

The assumptions for performing multiple linear regressions were checked in advance (58). Our sample size was $N = 107 > 100$. However, the number of predictors times ten ($18 \times 10 = 180$) was greater than our sample size, possibly leading to overfitting of regression models. Yet even two observations per parameter have been found to not bias the estimate in linear regression analysis (59). The variances inflation factors (VIF) were between 1 and 2.732 whereas a $VIF < 1$ and $VIF > 10$ indicates multicollinearity and the predictors explained the dependent variables ($R_s = 0.545\text{--}0.818$, $R^2_s = 0.297\text{--}0.669$). We did not calculate Durbin-Watson coefficients because our dependent variable (respective treatment outcome) was also in the model as an independent variable (pre-treatment score of the respective outcome) with a time lag and thus the application of the Durbin-Watson statistic is not warranted (60). Moreover, we inspected the distribution of the residuals (homoscedasticity and normal distribution) and checked for outliers. We identified one outlier based on the studentized residuals, however Cook's distances indicated that the case was not influential for our models (61). Therefore, we did not remove this outlier from the data (62).

RESULTS

Sample Characteristics

The total sample consisted of 107 German-speaking participants. On average, they were 40.36 years old ($SD = 14.59$, range = 18–81 years) and the majority were female ($n = 87$, 81.3%), had a university degree ($n = 64$, 59.8%) and previous experience with psychological treatment ($n = 68$, 63.6%). Overall, 28 participants (26.2%) were in concurrent psychological treatment and 24 participants (22.4%) were taking medication for psychological problems at baseline. The participants showed, on average, moderate depressive symptoms ($M = 10.37$, $SD = 4.18$) and mild anxiety and stress symptoms ($M = 4.33$, $SD = 3.26$; $M = 8.80$, $SD = 4.10$) at pre-treatment. Approximately one third of the participants ($n = 36$, 33.6%) reported having received a psychiatric diagnosis at some point in their lives. Baseline or pre-treatment scores of the predictor variables and outcome measures are displayed in **Table 1**. There was a significant group difference in terms of education ($\chi^2_{(1)} = 5.055$, $p = 0.025$),

indicating that participants in the immediate treatment group had a lower average level of education. Moreover, participants in the delayed treatment group completed significantly fewer modules of the intervention than participants in the immediate intervention group ($t_{(104.1)} = 2.719$, $p = 0.009$). Additionally, the delayed treatment group showed markedly lower pre-treatment depression scores compared to the immediate treatment group [immediate treatment group M (SD) = 11.13 (4.36) vs. delayed treatment group M (SD) = 9.60 (3.89)]. However, the group difference was not significant ($t_{(102.1)} = 1.908$, $p = 0.055$).

Identifying Predictors of Post-treatment Depressive Symptoms and Resilience

In a first step, variables predicting post-treatment depressive symptoms and resilience were identified using simple linear regressions. We controlled for pre-treatment scores of the corresponding outcome measures (depressive symptoms or resilience). The results of the single predictor analysis are displayed in **Table 2**. In a second step, the variables that met the previously defined threshold of a p -value below 0.05 were included in a multiple regression model (see **Tables 3, 4**). All models used centered predictor variables (grand mean-centered) to anticipate possible multicollinearity. Since the variable group (immediate vs. delayed treatment) was a significant covariate for resilience ($\Delta R^2 = 0.034$, $\beta = -0.184$, $p = 0.013$), it was entered in the respective multiple regression.

Predictors of Post-treatment Depressive Symptoms in Multiple Regression

Within the first multiple linear regression, we examined predictors for post-treatment depressive symptoms (see **Table 3**). The age of the participants at baseline was a significant predictor of post-treatment depressive symptoms [b (SE) = 0.043 (0.020), $p = 0.032$]. The older the participants were, the higher their depressive symptoms were post-treatment.

Predictors of Post-treatment Resilience in Multiple Regression

Table 4 displays the results of the second multiple linear regression, in which post-treatment resilience was the outcome. Both motivation at baseline [b (SE) = 0.092 (0.032), $p = 0.006$] and pre-treatment emotion regulation skills [b (SE) = 0.072 (0.036), $p = 0.047$] predicted post-treatment resilience. The higher the motivation of the participants to use the intervention was, the higher their resilience was post-treatment. Likewise, the better the emotion regulation skills of the participants were pre-treatment, the higher their resilience was post-treatment.

DISCUSSION

In the present study, we aimed to identify predictors of treatment outcome in users of an internet-based self-help intervention for COVID-19-related psychological distress. With regard to depressive symptoms, being younger predicted lower depressive symptoms after the 3-week intervention. With regard to resilience, higher motivation to use the intervention and

better emotion regulation skills pre-treatment predicted higher resilience after the 3-week intervention.

We found that higher age was associated with worse treatment outcomes regarding depressive symptoms. This finding is inconsistent with previous research on predictors of internet-based self-help interventions for depression, in which age was not predictive of treatment outcome (63–67). The present finding is not straightforward to explain but could be related to the specific circumstances of the COVID-19 pandemic. A possible explanation could be a differential influence of various COVID-19-related stressors on psychological distress depending on age and that the intervention under study provided better support in dealing with certain stressors. For example, in a sample of 22-year-olds, secondary consequences of the COVID-19 pandemic, such as disruption of lifestyle or economic disruption were more strongly associated with psychological distress than COVID-19-related health risk exposures (68). Moreover, in one study, avoidant coping moderated the relationship between COVID-19 related psychological distress and depressive symptoms more strongly in younger adults compared to older adults (69). Therefore, in an uncontrolled setting, younger adults might benefit more from an intervention fostering adaptive coping than older adults. Given that research increasingly suggests that young adults are particularly affected mentally by the COVID-19 pandemic, the present finding is promising, despite the difficult explanation (29–32). However, since the ROCO intervention did not significantly reduce depressive symptoms and the present study was uncontrolled, such improvements could also be observed in younger adults not using the intervention.

Regarding resilience, we found that higher motivation to use the intervention and better emotion regulation skills pre-treatment predicted better treatment outcome. To date, there have been no studies examining predictors of treatment outcome in interventions promoting resilience, let alone internet-based interventions. However, in an internet-based self-help intervention for stress, higher motivation seemed to predict better adherence (70). Accordingly, it could be assumed that the effect of higher motivation on treatment outcome regarding resilience is mediated by adherence in our study as well. Yet, this assumption is not supported by our data, as the number of completed modules did not predict the treatment outcome in terms of resilience [$b(SE) = 0.162 (0.226)$, $p = 0.475$]. However, these results could be attributed to the fact that we measured adherence only by the number of completed modules. Some studies point out that adherence involves much more than mere technological usage (71, 72). Therefore, it could be possible that highly motivated participants are otherwise more engaged with the internet-based intervention, for example, by addressing the content of the intervention in more depth or implementing it more thoroughly in their daily lives, which in turn could improve treatment outcome.

In addition to motivational conditions, better pre-treatment emotion regulation skills also appear to predict better treatment outcomes in an internet-based intervention for COVID-19 related psychological distress in terms of resilience. The better treatment outcome regarding resilience in participants with better pre-treatment emotion regulation skills could be caused

by so-called capitalization. Capitalization describes the fact that pre-existing strengths of patients are reinforced and built on in therapy (73). In one study, tailoring treatment by focusing on patients' respective strengths rather than on their respective deficits led to better treatment outcomes in depressed patients (74). Since the intervention under study focuses, among other aspects, on building emotion regulation skills, it could be argued that emotion regulation skills were capitalized in participants with better pre-treatment emotion regulation skills. Previous research found that emotion regulation skills are associated with higher resilience (75) and better emotional adjustment (76). Therefore, capitalizing emotion regulation skills might lead to benefits in resilience. In conclusion, it appears that in the present study, participants with higher pre-treatment resources (motivation or emotion regulation skills) improved more during an internet-based self-help intervention regarding resilience in an uncontrolled setting.

In the current study, multiple possible predictor variables did not predict post-treatment depressive symptoms and resilience. For example, female gender predicted neither treatment outcome. This finding is consistent with studies that found no effect of female gender on treatment outcome (63–65, 77). However, there are also some studies that have shown that female gender predicted better treatment outcome (78–80).

The current study comes with several limitations. First, our sample was relatively small for predictor analysis. Our analyses might have been underpowered since predictor effects in internet-based interventions tend to be small. In addition, the small sample size in combination with the applied prediction procedure leads to an increased chance of incidental findings. Moreover, as only participants with complete data sets were included in the analysis, sample size was further reduced for some outcomes due to drop-out. To prevent further reduction of our sample, other methods (e.g., multiple imputation) could have been used to address missing data instead of listwise deletion. However, we decided to do a completer analysis instead of an intention-to-treat analysis. Second, participants in the delayed treatment group [$M (SD) = 2.89 (2.53)$] completed significantly less modules than participants in the immediate treatment group [$M (SD) = 4.15 (2.27)$; $t_{(104.1)} = 2.719$, $p = 0.009$], whereas the effect size was $d = 0.52$ (medium effect size). One possible reason for this result could be that the burden of the participants in the delayed treatment group has already decreased during the waiting period. Accordingly, participants in the immediate treatment group showed higher mean depression scores [$M (SD) = 11.13 (4.36)$] than participants in the delayed treatment group [$M (SD) = 9.60 (3.89)$]. However, this difference was not significant ($t_{(102.1)} = 1.908$, $p = 0.055$). The current sample might have been already less burdened at pre-treatment, and therefore might not be representative of people with COVID-19 related psychological distress actively seeking support. Third, we relied only on self-report outcome measures and did not conduct a clinical assessment. Accordingly, responses could be subjectively biased. This could particularly concern information on psychological burden. Fourth, despite several analyses, we did not correct for multiple tests. Accordingly, this could result in type 1 errors. Nonetheless, since analyses were exploratory,

avoiding type 2 errors is crucial. However, results must therefore be considered as hypotheses generating and not as definitive findings (81). Fifth, we have not analyzed moderators of treatment outcome. Therefore, we cannot answer whether the ROCO intervention was more effective for certain participants (e.g., younger adults) when compared to a control group. Based on our analyses we can only draw preliminary conclusions about which participants benefitted more in an uncontrolled setting. Sixth, we refrained from using modern prediction methods which might lead to difficulties in replicating our results (56, 82).

CONCLUSION

Despite the limitations mentioned above, the current study gives preliminary evidence on the relationship between participant characteristics and treatment outcome in internet-based self-help interventions for COVID-19 related distress. One promising finding is that young adults, who can be considered a psychologically vulnerable group in the COVID-19 pandemic, seem to improve more using such an intervention in terms of depressive symptoms. Moreover, participants with higher motivation and better pre-treatment emotion regulation skills seemed to be able to build on their strengths and showed better treatment outcome in terms of resilience. Therefore, it could be beneficial to tailor interventions to respective strengths of the participants in order to promote resilience. However, further studies are needed to make informed decisions about the relationship of participant characteristics and treatment outcome in internet-based self-help interventions for COVID-19 related psychological distress. First, in further studies, the hypotheses generated in this exploratory analysis should be verified. Second, further studies should be conducted in a controlled setting to draw conclusions

about the individuals for whom such an intervention is most effective.

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 the Canton of Bern. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

NB drafted the manuscript and was responsible for its conceptualization, methodology, formal analysis, data curation, and writing. JH was responsible for data curation and writing—reviewing and editing. TB and HZ were responsible for project administration, resources, and writing—reviewing and editing. All authors contributed to the article and approved the submitted version.

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College Students' Opinions About Coping Strategies for Mental Health Problems, Suicide Ideation, and Self-Harm During COVID-19

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Background: Mental health problems have emerged as a significant health complication in United States colleges during COVID-19, and as a result, they have been extensively investigated in the United States and internationally. In contrast, research on coping among the college population during the pandemic is scant. Hence, this study investigated coping strategies proposed by undergraduate students attending a Midwestern university.

Objectives: The purpose of this preliminary study was to obtain college students' feedback/opinions about coping strategies for mental health problems, suicide ideation, and self-harm during COVID-19.

Methods: In December 2021, one-hundred and four undergraduate students (ages 18–22 years) completed an online survey on coping strategies using Qualtrics. Major topics included: (1) Types of coping strategies/styles expressed by students for general mental health problems, (2) Types of coping strategies for suicide ideation and self-harm behaviors, (3) Preferred platforms for receiving coping therapy, and (4) Reasons for accepting or refusing parent involvement with mental health problems.

Results: The most beneficial coping strategies for mental health were ranked by college students as follows: (1) a skills training development program (30%), (2) meditation (19%), and (3) mindfulness exercises (15%), and physical education (11%). The respondents' best coping strategies for preventing self-harm and suicide ideation/behaviors during COVID-19 were ranked as: (1) improving support from friends (32%), (2) building self-esteem (29%), and (3) addressing anger, depression, stress, and loneliness (25%). Finally, a total of 50% of participants felt that parents should be involved in college student interventions. Students stated that the most important type of support that they received from their parents were: (1) emotional support (31%), (2) direction and/or assistance with solutions (27%), and problem-solving (16%).

Conclusion: This study identified potential avenues which could be implemented into action during future outbreaks. Specifically, employing interventions that: (i) train undergraduate students to employ more effective skills training coping strategies or

practicing mindfulness or meditation; (ii) integrate mental health, suicide, and self-harm prevention into the curriculum; (iii) offer more in-person campus services targeted toward the psychological and emotional effects of a pandemic, and (iv) involve support persons (e.g., family) in students' lives to enhance their well-being during and after COVID-19.

Keywords: coping, college students, COVID-19, mental health problems, suicide ideation, self-harm, skills training, family support

INTRODUCTION

The unanticipated and traumatic effects of COVID-19 and quarantining since January 2020 have negatively impacted the mental health of undergraduate college students. Researchers have primarily evaluated social stress and academic stress (Vidal Bustamante et al., 2022), anxiety (Brooks et al., 2020; Kochuvilayil et al., 2021; Bountress et al., 2022; Kaur et al., 2022; Song et al., 2022; Tshering and Dema, 2022), anger (Brooks et al., 2020), and depression (Brooks et al., 2020; Bountress et al., 2022; Tshering and Dema, 2022) in this vulnerable population. In addition, a plethora of other reported outcomes during COVID-19 included loneliness (Xiang et al., 2020; Kaur et al., 2022), isolation (Hasratian et al., 2021; Kaur et al., 2022), sleep disturbance/difficulty sleeping or insomnia (Kochuvilayil et al., 2021; Zhang et al., 2021; Song et al., 2022), fatigue (Mosleh et al., 2022), burnout (Kagawa et al., 2021), PTSD (Brooks et al., 2020; Bountress et al., 2022), future uncertainty (Miconi et al., 2022), witnessing death in relatives (Hasratian et al., 2021), relocation/displacement (Hasratian et al., 2021), alcohol (Bountress et al., 2022), e-cigarette (Merianos et al., 2022), and cannabis use (Merianos et al., 2022; Merrill et al., 2022), financial insecurities, loss or stressors of income (Hasratian et al., 2021), unhealthy eating behaviors (Kochuvilayil et al., 2021), academic concerns (Kochuvilayil et al., 2021; Vidal Bustamante et al., 2022), contagion (i.e., fear of contracting the disease; Wheaton et al., 2021), mobile phone addiction (Jiang et al., 2022; Peng et al., 2022), relationship problems (Gallegos et al., 2021; Herbenick et al., 2022), sexual activity problems (Ellakany et al., 2022; Herbenick et al., 2022), increased screen time (Ellakany et al., 2022), suicidal behavior (López Steinmetz et al., 2021; Bountress et al., 2022; Rahman et al., 2022), self-harm (Kim et al., 2021), and fear of death (Xiang et al., 2020).

The overwhelming majority of studies on this population have focused on the symptomology of mental illness. Prevention of COVID-related psychological effects through coping strategies in college students is profoundly absent from the literature.

Hence, our study sought to address this gap by obtaining undergraduate University of Illinois students' opinions on the most appealing/beneficial coping strategies that would empower college students during the ongoing pandemic as well as determine which coping strategies would lessen or prevent self-harm and suicide ideation/behaviors. Finally, students were queried about what type of support parents provided to students while attending college. We intentionally did not inquire about students' mental health problems, treatments, and suicide and self-harm histories. Rather, we purposely concentrated on

students' perceptions of how to best tackle mental health issues in a college population.

There are three types of coping strategies: problem-focused, emotion-focused, and avoidance-focused situations described in the literature (Baqtayan, 2015). The most widely reported problem-focused coping strategies are active coping (e.g., problem understanding and solving) and seeking social support for instrumental reasons (e.g., asking others for help and developing social support; Chaabane et al., 2021). Positive reinforcement and growth (e.g., staying optimistic and wishful thinking) and turning to religion, are the most widely used emotion-focused stress coping strategies (Chaabane et al., 2021). In contrast, the most commonly used types of avoidance or dysfunctional coping strategies are mental disengagement (e.g., transference, becoming involved in other activities) and behavioral disengagement (e.g., avoidance, social withdrawal; Chaabane et al., 2021). In our study, coping choices centered around active coping, seeking social support, and mental disengagement.

METHODS

Participants and Procedure

An online survey was administered through Qualtrics to Community Health majors enrolled in a Public Health (PH) Research Methods course at the University of Illinois Urbana-Champaign in Fall 2021. Study participants were compensated for their time with five extra credit points. A total of 104 students in the PH methods course completed the survey, reflecting a 100% response rate. Students were eligible if there were 18 years of age or older and enrolled in the above-mentioned PH course.

All participants received a link to Qualtrics that included an electronic informed consent document explaining the study, the brief survey, and a separate form used to collect information for assigning bonus participation points. Participants concluded the survey online and the average time to completion was about 5–8 min. This study involved human participants and was reviewed and approved by the University of Illinois Institutional Review Board. The participants provided their written informed consent to participate in this study.

Measures

A newly designed 9-item survey instrument was designed to assess: (1) Types of coping strategies/styles expressed by students for general mental health problems, (2) Types of coping strategies/styles expressed by students for suicide ideation, and self-harm behaviors, (3) Preferred platforms for receiving

TABLE 1 | Demographics of the undergraduate college students.

Field	N Students	(%)
Gender		
Female	19	20%
Male	76	80%
Age		
19	30	32%
20	42	44%
21	18	19%
22	5	5%
Race		
White	41	39%
Black/African American	24	23%
American Indian/Alaska Native	2	2%
Asian	21	20%
Native Hawaiian/Pacific Islander	2	2%
Other	15	14%
Year		
Sophomore	35	37%
Junior	48	51%
Senior	12	13%

coping therapy, and (4) Reasons for accepting or refusing parent involvement with mental health problems. The initial approach to designing this survey was to focus on coping by promoting strengths and protective factors rather than on targeting deficits (Houston et al., 2017). Students were asked to rank (from highest to the lowest order of preference) potential coping strategies to: (i) promote good mental health, and (ii) prevent suicide ideation and self-harm behaviors. They were also provided with an “other” category to disclose additional strategies of their choosing.

Statistical Analysis

All analyses were descriptive in nature and were performed using Qualtrics.

RESULTS

The majority of students in this study were 19 or 20 years of age (76%). Half of the students were enrolled as juniors, while the rest were sophomores (37%), or seniors (13%). Eighty percent of the students identified themselves as female. Forty percent of participants were white, 24% were black, 21% were Asian, 15% were other (Latino/a, Hispanic, or interracial), and 2% were American Indian or Alaska Native (Table 1).

The most beneficial coping strategies for mental health were ranked by college students as follows: (1) a coping skills development program (30%), (2) meditation (19%), (3) mindfulness exercises (15%), and physical education (11%; Table 2).

The respondents' best coping strategies for preventing self-harm and suicide ideation/behaviors during COVID-19 were ranked in this way: (1) improving support from friends (32%), (2) building self-esteem (29%), (3) addressing anger, depression,

stress, and loneliness (25%), (4) improving support (building bridges) with family (19%), (5) managing substance abuse (10%), (6) improving or developing resilience (10%), and (7) enhancing time management and goal-oriented behaviors (5%; Table 3).

The platforms that were deemed most beneficial by students in order to help them deal with mental health issues were: (1) visiting the campus Counseling Center or other mental health services in-person (68%), (2) going to resident advisor-led training sessions in-person (19%), and (3) attending resident advisor-led training sessions online (13%).

Finally, a total of 50% of participants felt their parents should be involved in college coping interventions for mental health while 35% were unsure about their parents' participation. The remaining 15% of students reported that parents should not be involved in college interventions that employed coping strategies.

Students stated that the most important type of support that they received from their parents was: (1) emotional support (31%), (2) direction and/or assistance with solutions (27%), (3) problem-solving (16%), or (4) a calming effect (13%; Table 4).

DISCUSSION

Our study revealed that during COVID-19, skills training, meditation, and mindfulness were the preferred methods chosen by undergraduate college students to cope with mental health problems. Additionally, in the areas of self-harm and suicide ideation, students perceived support from friends and family as most beneficial.

Skills Training

Skills training development programs protect mental health and prevent suicide for teens and young adults in the United States (JED Foundation, 2021). There were no United States studies that reported the impact of skills training and coping during the pandemic in college students. However, in a study of 386 Nigerian undergraduate students (with a 21% response rate), students coped with the lockdown and the cessation of academic activities during COVID-19 by engaging in online skills-acquisition building activities (15.3%), using social media (17.9%), and watching television or videos (11.1%; Ojewale, 2021). Face-to-face skills-building activities were not evaluated in this study (Ojewale, 2021).

Mindfulness and Meditation

An online intervention was used to test (Dorais and Gutierrez, 2021) the effectiveness of a 4-week centering meditation treatment, which proved to be successful in improving levels of stress and trait mindfulness in a college population (Dorais and Gutierrez, 2021). A second randomized clinical trial assessed the effectiveness of an 8-week, web-based mindfulness and cognitive behavioral therapy program in reducing symptoms of depression, anxiety, and stress (primary outcomes) and increasing mindfulness (secondary outcome) in 160 undergraduate students at a Canadian university. Using video-based modules, peer-to-peer discussions, and anonymous group-based video discussions, there were

TABLE 2 | Ranking of coping strategies for mental health by college students.

Coping strategies*	Ranked as 1st choice		Ranked as 2nd choice		Ranked as 3rd choice	
	N	%	N	%	N	%
Coping development program to enhance mental health	25	29%	7	8%	10	12%
Mindfulness exercises	15	17%	19	22%	13	15%
Meditation	19	22%	16	19%	13	15%
Mindfulness based Art therapy	9	10%	6	7%	11	13%
Physical education (in person or web based)	11	13%	12	14%	12	14%
Peer support programs	9	10%	11	13%	12	14%
Use of social media for relaxation technique	7	9%	9	11%	7	9%

* "Other" category was not presented because none of the students ranked it in their top three choices.

TABLE 3 | Ranking of coping strategies for suicide ideation and self-harm behaviors.

Coping strategies*	Ranked as 1st choice		Ranked as 2nd choice		Ranked as 3rd choice	
	N	%	N	%	N	%
Improving support from friends	28	32%	11	13%	8	9%
Improving support (Building bridges) with family	19	22%	13	15%	15	17%
Building self-esteem	25	28%	17	19%	13	15%
Addressing anger, depression, stress, and loneliness	22	25%	12	14%	15	17%
Managing substance abuse	9	10%	5	6%	10	11%
Enhancing time-management and goal-oriented behaviors	5	6%	13	15%	4	5%
Improving or developing resilience	9	10%	7	8%	7	8%
Working at a job (Volunteer or paid)	7	8%	3	3%	3	3%

* "Other" category was not presented because none of the students ranked it in their top three choices.

TABLE 4 | Type of support offered by parents to undergraduate college students.

Type of support:	N	%
Problem solving	14	16
Emotional support	28	32
Calming effect	11	13
Providing direction and/or assisting with solutions	24	27
I do not currently ask for and/or receive support from my parents/family	11	13

significantly reduced depression and anxiety symptoms but no effects on perceived stress (El Morr et al., 2020). The Koru mindfulness 4-week curriculum (embedded within a college course) intervention increased state mindfulness, decreased stress, and improved sleep during the pandemic in 34 undergraduate students compared to students ($N = 35$) enrolled in a different course (Smit and Stavoulaki, 2021). A pilot trial suggested that both mindfulness and social support delivered *via* mobile Health, showed promise in reducing distress among 114 young college adults in quarantine in China, with mindfulness being particularly effective in addressing anxiety (Sun et al., 2022). Last, in 99 college students ranging in age from 18 to 29 years, emotional intelligence and mindfulness training using the Ajivar app during COVID-19 resulted in improvements in anxiety, depression, and emotional intelligence (Sturgill et al., 2021).

Face to Face vs. Online Mental Health Care

In contrast to the above mentioned five studies, our study determined that students greatly preferred face-to-face mental health care rather than online platforms in order to receive coping strategies. This could be a result of our study being performed 2 years into the pandemic when isolation and loneliness were very prevalent. In one recent small Italian study ($n = 34$), the online counseling intervention was almost as effective as the face-to-face counseling intervention with respect to psychological distress; however, face-to-face counseling was superior to online counseling with regard to university students' life satisfaction before and during COVID (Ierardi et al., 2022). Since life satisfaction is associated with better physical health, higher performance, and stronger social relationships (Tsaousides, 2018), this is a meaningful finding when considering university students' quality of life. In the future, more in-person mental health and coping interventions should be explored within college populations.

Social Support

In our study, both parent and friend involvement were identified as coping strategies for suicide ideation and self-harm within our college population during the COVID-19 epidemic. Within the literature, only one study involved friends, proposing the fitness buddy program model as an innovative and cost-efficient strategy to support college students' psychological well-being

and long-term success during COVID (Kirby et al., 2022). With respect to family support, one of the main coping activities employed by 381 University Jordanian students, ages 18–38 years, consisted of more engagement with family (53%); albeit, the most common reported coping strategy was spending more time on social media platforms (71%; Al-Tammemi et al., 2020).

Another study reported that healthy family function may alleviate general anxiety disorder and anxiety of college students during the COVID-19 pandemic (Yang et al., 2021). A cross-sectional study in 2020 consisting of 558 undergraduate students from seven geographical regions across China reported that a large percentage of college students adopted passive coping strategies such as smoking and drinking, which were detrimental to their mental health (Huang et al., 2021). However, family support was very important for protecting against anxiety, depression, and stress (Huang et al., 2021).

Limitations

Skill building, meditation, mindfulness, friends' support, addressing self-esteem, managing anger, depression, stress, and loneliness, and involving parents surfaced as top-ranking coping strategies in our study. Nevertheless, several limitations should be acknowledged. This was a cross-sectional design so causal relationships between coping strategies and decreased mental health problems could not be inferred. All coping strategies were inquired through self-report and no alternative assessments were used. Students were not queried about their own mental health problems or whether they received help and support for them; rather, they only provided their beliefs/opinions about coping strategies. Thus, mental health diagnoses were not obtained or verified. Data were only collected from a single Midwestern college among students in a health-related major and convenience sampling was used to recruit participants; therefore, generalization of the findings is limited. This study contained a small sample size which did not allow for the analysis of predictor variables and examination of interaction effects. The cohort may not be fully representative of a student population based on the narrow age range and majority of the sample being female. It is possible that students may be more psychologically minded and aware of the types of beneficial help and support for emotionally related situations in light of them being "majors enrolled in a PH Research Methods course." Additionally, the 100% response rate could reflect that students were motivated to help in the field of understanding mental health issues or alternatively, their motivation could be a result of only being interested in receiving five extra credit points.

Future Recommendations

The importance of what students can do for themselves, as well as what their friends and family can do to help to

support and positively influence them, are important findings not just in relation to COVID-19 but also in the world post-COVID. Based on the results of this descriptive study, examples of specific university actions that may warrant further evaluation using randomized clinical trials are: (1) engaging and educating parents about how to best support their loved ones on campus during and after any pandemic, (2) determining how to expand platforms to support face-to-face student mental health during crises, and (3) offering self-care student activities on campuses such as coping skills development/building, mindfulness, and meditation classes.

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 involved human participants and was reviewed and approved by the University of Illinois Institutional Review Board. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

The author conceptualized the research and methodology, obtained human subjects approval, participated in draft writing and manuscript preparation, administered the surveys online, and approved the final manuscript.

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Vaccination against COVID-19 reduces virus-related fears: Findings from a German longitudinal study

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During the recent pandemic, fear of COVID-19 has been widespread and is considered to deteriorate mental health. We assessed whether vaccination can effectively reduce the fear of COVID-19 and, thus, contribute to improving people's mental health status. We used two-wave panel data from a German online study collected in April 2021 (t1) and August/September 2021 (t2) and estimated differences-in-differences to determine whether those who were vaccinated against COVID-19 experienced a reduction of fear of COVID-19, and whether the reduction was more evident as compared to people who were not vaccinated for various reasons. Fear of COVID-19 generally decreased between t1 and t2 for all respondents. Moreover, reduction of fear for people who were unvaccinated at t1 but received the vaccine between t1 and t2 was strongest as compared to people who did not get vaccinated during that period, even after we controlled for factors associated with fear (e.g., age, gender). Vaccination reduced fear of COVID-19 beyond some seasonal fluctuation and, therefore, we argue that vaccination partially reduces the psychological distress caused by the pandemic. We recommend that scientists, practitioners, and politicians highlight this additional positive effect of vaccination in health communication.

KEYWORDS

COVID-19, vaccination, fear of COVID-19, mental health, differences-in-differences

Introduction

The COVID-19 pandemic has sparked concerns around the globe. People express these concerns as fear of negative health consequences, hospitalization, and dying from an infection (1, 2). Moreover, fear of COVID-19 increases general levels of psychological distress, post-traumatic stress symptoms, panic disorder, insomnia, anxiety, and depression (1–4). At the same time, fear of COVID-19 propels compliance with regulations to contain the virus and increases the willingness to get vaccinated (5–7). Does vaccination lead to a sense of security? If yes, a reduction in the fear of COVID-19 should be measureable when comparing levels of fear of

individuals who seized the opportunity and received a vaccination once it was available with the levels of fear of individuals who did not. Since 2021, the possibility to receive an injection of any of the approved vaccine types was granted on a priority basis according to age, health issues, contact with vulnerable groups, and working in system-relevant professions (8). By late summer 2021, every resident wishing to be vaccinated had received the opportunity to do so. Yet, according to the data from the Robert Koch Institute, by November 2021 only about 70% of the eligible population had used this opportunity. Thus, strategies to further disseminate the vaccines and increase vaccination willingness are needed.

Social and personal reactions to the pandemic and related fears and concerns are strongly linked to information processes, and it is therefore useful to coordinate the efforts to improve vaccination programs and developments of effective reactions to the pandemic (9). Especially in the early stages of the pandemic, such efforts had to circumvent misinformation (and even disinformation) before developing useful reactions. By now, the evidence regarding the effect of the virus and vaccination on peoples' fear of COVID-19 is more compelling. For example, recent studies have indicated that fear of COVID-19 is related to various mental health outcomes such as anxiety and depression and even higher suicide risk (3, 4, 10). A recent systematic review and meta-analysis has reported excessive levels of fear of COVID-19 around the world (2). Another comprehensive review demonstrated that different population groups tend to experience different levels of fear (1). Specifically, women, younger adults, urban residents, divorced people, healthcare workers, as well as people in quarantine settings, people with suspected COVID-19 infection, and people with mental health problems were found to be at risk of excessive fear of COVID-19. These findings suggest that higher fear of COVID-19 should increase vaccination intentions and encourage the population to follow national vaccination recommendations. However, some studies also report a reversed effect, that is, vaccination decreases fear of COVID-19 (11–13). Accordingly, people who received the COVID-19 vaccine were more likely to report decreased mental distress levels afterwards than their unvaccinated counterparts. Thus, receiving the vaccine results in improvements in mental health.

The current study aims at exploring whether and to what extent people in Germany vaccinated against COVID-19 decreased their level of fear of the virus as compared to their unvaccinated counterparts. We use panel data (i.e., data from the same individuals) across two time points (late April 2021 and late August/early September 2021), which allows us to conduct a (quasi-experimental) “pre-post testing” analysis. In addition, we distinguish the following groups of individuals according to their vaccination status: (1) individuals vaccinated between the first and the second measurement time point; (2) individuals vaccinated prior to the first time point; (3) vaccination refusers, namely, individuals unvaccinated by the second measurement

time point, reporting that they “do not want to be vaccinated”; and (4) unvaccinated individuals at the second measurement time point for other reasons such as “not received an offer” or “not yet arranged an appointment”. We expect differences in levels of fear of COVID-19 between these groups. The highest level of fear of COVID-19 is expected for people who got vaccinated either between the first and second measurement time points (group 1) and for people vaccinated prior to the first measurement time point (group 2). We assume that people with a higher initial level of fear were more likely to take the opportunity to do something to alleviate their fears and get vaccinated (*Hypothesis 1*). By way of contrast, and for the same reason, we expect the level of fear of COVID-19 of vaccination refusers (group 3) to be lowest (*Hypothesis 2*). Finally, we expect people in group 1—after receiving the first vaccination—experienced the highest reduction of fear of COVID-19 as compared to other groups (*Hypothesis 3*).

Materials and methods

Study design and participants

We used an ongoing German online access panel by the market research institute Respondi AG (14) to collect the data repeatedly from the same participants. Thus, the design of our study is a prospective panel design, and the data reflect current changes in the characteristics under study. However, participants also provided some information retrospectively, such as their vaccination status since the last data collection. Study participants were recruited online via campaigns, marketers, and by self-recruitment and, after registering, participants received an e-mail invitation to take part in the study voluntarily. They did not sign a separate consent form for this study, and they received an incentive of 0.75 euro for their participation. The company used quotas for gender, age, education, income, and immigration background to achieve comparable rates in the sample to those in the German population (15). The share of people with an immigration background in the sample (17%) was below the share provided by German microcensus data (25%). All other quotas were met. The study was approved by the ethics committee of the Faculty of Management, Economics and Social Sciences, University of Cologne (reference numbers: 210005DS and 210031DS).

The first wave (t1) of data was collected between April 9 and April 28, 2021 and the second wave (t2) was collected between August 23 and September 9, 2021, addressing the same participants. Of the 5,044 respondents who participated in the first wave, 3,458 were re-interviewed in the second wave. In this study, we focused only on the respondents who participated in both waves and provided valid information on their vaccination status and fear of COVID-19. Thus, the effective size of the two-wave panel sample was 3,428. In this sample, 27% of

the respondents were aged 60 or above (mean age 49), 54% were male, 23% reported a polytechnic or University degree of education, 29% reported having low income (a maximum of 2,000 € per month), and 17% reported having an immigrant background (with at least one parent born outside of Germany). The rates of people aged 60 or above and males were lower in the original first wave sample (23 and 50%, respectively) than in the two-wave panel sample.

Due to the slow start of the vaccination campaign and initial shortages of vaccines, only a small proportion of the German population had received their first vaccination by mid-April 2021 (19.6% on April 17 according to the Robert Koch Institute (RKI) and the Federal Ministry of Health) (16). In our first wave of the data collection, 19.4% of the respondents reported being vaccinated at least once. On June 7, 2021, the German government suspended all vaccination restrictions that prioritized people of older age, with pre-existing health issues, in certain jobs (e.g., health care), and with social and economic disadvantages. Thus, between our first and second data collection, all citizens theoretically had the opportunity to be vaccinated at least once. In our second wave of data collection, 82% of the respondents reported they received at least one vaccination. The official data showed that only 65.7% of the general population were vaccinated once by September 1, 2021 (16). This discrepancy may indicate a selection of vaccinated people into the second wave of the study but it may also reflect that the study sample included only adults aged 18–74 years.

Fear of COVID-19 is the outcome variable of this study. Differences between people that are vaccinated or unvaccinated can be conceptualized as counterfactual states such as

y_0 = fear of COVID-19 without vaccination

y_1 = fear of COVID-19 with vaccination

meaning that if unvaccinated, fear of COVID-19 is y_0 and y_1 otherwise. Thus, if the vaccination status does not change across time and everything else being equal across groups, differences in the fear of COVID-19 are solely attributable to group differences and cross-time fluctuations that apply to each group equally. A change in vaccination status is assumed to change the level of fear of COVID-19 over and beyond group differences and cross-time fluctuations. These assumptions correspond to a differences-in-differences (DiD) design for two groups and two time points (17).

Based on the data on vaccination status in our study, we distinguished between four groups across two time points (Table 1): people vaccinated between the first and second waves (group 1); people vaccinated prior to the first wave (group 2); vaccination refusers, namely, unvaccinated until the second wave, reporting that they “do not want to be vaccinated” (group 3); and unvaccinated until the second wave not due to refusal but for other reasons such as “not received an offer” or “not yet arranged an appointment” (group 4). Thus, only group 1 had experienced a change in vaccination status between the waves of data collection. Notably, the group composition was

not random, because a substantial proportion of individuals may have self-selected themselves into getting vaccinated as soon as they had the opportunity to receive or refuse a vaccination. In addition, we controlled in our analysis for age, gender, education, income, and immigration status to account for different levels of fear of COVID-19 as a function of these characteristics.

Measures

We measured fear of COVID-19 using three indicators that resemble a scale that has been developed to assess fear of COVID-19 in the general population (18): (1) “When I think of the coronavirus, I feel threatened” (fear₁); (2) “I am worried that I or people I love could get sick from the coronavirus” (fear₂); (3) “I am stressed in the presence of other people, because I am afraid that I may catch the coronavirus” (fear₃). Respondents were asked to rate these statements on a scale ranging from 1 (strongly disagree) to 7 (strongly agree). All indicators were assessed at both waves (t_1 and t_2), with a negligible missing values rate below 1%. Descriptive statistics for the indicators measuring fear of COVID-19 can be found in the Supplementary Table S1. Subjective measures of fear may require a higher effort of validation and may be less reliable than other measures. However, we had no access to diagnostic (physiological) tests of fear, and we aimed to assess the subjective feeling of an anticipated threat or harm from the virus.

Statistical analysis

We used confirmatory factor analysis to assess how well the subjective measures capture the construct fear of COVID-19 and to control for measurement error that may compromise the validity and reliability of the results (19). Thus, fear of COVID-19 was treated as a latent variable measured by multiple observed indicators (fear₁–fear₃) in multiple groups (group 1–group 4) and across multiple time points (t_1 and t_2). In addition, we tested if the measurements of fear of COVID-19 are invariant across groups and time (20). Measurement invariance is a prerequisite for comparing latent means and latent mean differences across groups and time. It ensures that the group- and time-specific means of a latent variable (i.e., fear of COVID-19) are not biased due to systematic differences in measurement instrument properties across groups and due to systematic shifts in response behavior across time that do not correspond to real differences or change of the construct.

The group- and time-specific latent means were used to calculate the differences-in-differences following the structured means modeling (SMM) approach, (21) which is implemented in structural equation modeling (SEM) (22). Therefore,

TABLE 1 Study groups and descriptive statistics.

	N (%)	Vaccinated at least once at t_1 ?	Vaccinated at least once at t_2 ?	Mean age	% Male	% High education	% Low income	% Immi- grants
Group 1: vaccinated between t_1 and t_2	2,139 (62.40)	No	Yes	49.0	55.4	24.0	27.6	16.6
Group 2: vaccinated prior to t_1	683 (19.92)	Yes	Yes	53.0	55.0	22.5	25.0	13.3
Group 3: refusers	399 (11.64)	No	No	45.4	46.9	15.8	40.1	18.6
Group 4: unvaccinated for other reasons	207 (6.04)	No	No	42.3	51.2	22.2	39.1	24.6
Total sample	3,428 (100.00)			49.0	54.1	22.6	29.3	16.7

High education, polytechnic or University degree; low income, a maximum of 2,000 €; immigrants, at least one parent born outside of Germany.

we included the following differencing equations into the model estimation:

DiD for:	Equations
group 1 and group 2	$ DiD_1 = (g_1t_2 - g_1t_1) - (g_2t_2 - g_2t_1)$
group 1 and group 3	$ DiD_2 = (g_1t_2 - g_1t_1) - (g_3t_2 - g_3t_1)$
group 1 and group 4	$ DiD_3 = (g_1t_2 - g_1t_1) - (g_4t_2 - g_4t_1)$
group 2 and group 3	$ DiD_4 = (g_2t_2 - g_2t_1) - (g_3t_2 - g_3t_1)$
group 2 and group 4	$ DiD_5 = (g_2t_2 - g_2t_1) - (g_4t_2 - g_4t_1)$
group 3 and group 4	$ DiD_6 = (g_3t_2 - g_3t_1) - (g_4t_2 - g_4t_1)$

A path diagram displaying the estimated model is presented in [Figure 1](#).

We assessed the fit of the models to the data by considering standard SEM goodness of fit statistics (23). The chi-square (χ^2) test statistic tests the null hypothesis that the model-implied and population covariances are equal given the model degrees of freedom (df). However, with larger sample sizes, the power of the χ^2 test to detect even very small differences between model-implied and population covariances increases, which leads to an excessive rejection of useful models. Therefore, we consider two alternative fit indices based on χ^2 . The comparative fit index (CFI) compares the estimated model to a null model and ranges between 0 and 1. Model fit is considered acceptable when the CFI statistic is close to or above 0.95. The root mean square error of approximation (RMSEA) is a measure of discrepancy of the estimated and a (perfectly fitting) saturated model and ranges between 0 and ∞ . Model fit is considered acceptable when the RMSEA statistic is close to or below 0.08.

All models were estimated using the lavaan package in the R environment (24). Estimates were obtained using robust (full-information) maximum likelihood estimation. Annotated R code and output can be found in the [Supplementary material](#).

Results

First, we estimated an unconstrained confirmatory factor model for fear of COVID-19 at t_1 and t_2 for the entire sample to assess the factor loadings and reliability (see [Supplementary material](#) for details). The model fitted the data well: $\chi^2 = 28.432$ (df = 5, $p < 0.001$), CFI = 0.998, RMSEA = 0.043. The standardized factor loadings of the indicators measuring fear of COVID-19 were high in magnitude and ranged between 0.740 and 0.911 indicating that a sufficient degree of variance in the observed indicators is explained by the latent variables. Omega reliability coefficients were 0.857 (t_1), 0.872 (t_2), and 0.893 (total).

Second, we assessed measurement invariance of the latent variable fear of COVID-19. Results indicated that scalar invariance (i.e., equal factor loadings and indicator intercepts) holds between groups and across time simultaneously. This allowed us to make valid comparisons of the latent means of fear of COVID-19 (see [Supplementary material](#) for comparisons of fit statistics and further details).

Third, we estimated the model to test the hypothesized latent means and latent mean differences. In this model, again, factor loadings and indicator intercepts were held equal across groups and time. The model showed good fit to the data: $\chi^2 = 442.869$ (df = 148, $p < 0.001$), CFI = 0.976, RMSEA = 0.049. The standardized factor loadings were between 0.668 and 0.911. Regarding the latent mean level of fear of COVID-19, [Table 2](#) shows that unvaccinated individuals (group 4), those vaccinated between t_1 and t_2 (group 1), and those vaccinated prior to t_1 (group 2) had the highest level of fear of COVID-19 at t_1 , partially

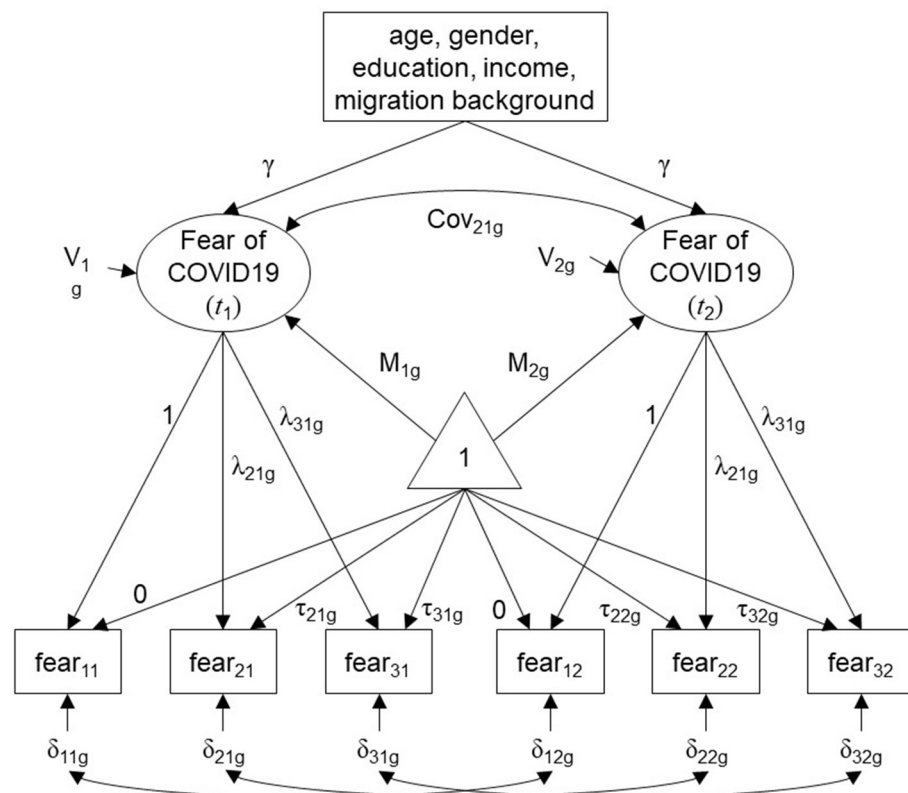


FIGURE 1

Path diagram displaying the estimated model following the SMM approach. Observed indicators and covariates in rectangles; latent variables in ellipses; subscript “g” refers to the study groups; V, variance of the latent variable; M, mean of the latent variable; Cov, covariance between latent variables; triangle containing “1”, unit-constant pseudo variable capturing the mean structure; γ , coefficients for the regression of fear of COVID-19 on covariates (constrained to be equal across time); λ , factor loading (loadings for indicators fear_{11} and fear_{12} were fixed to 1 for identification); τ , indicator intercept (intercepts for indicators fear_{11} and fear_{12} were fixed to 0 for identification); δ , residual variance.

TABLE 2 Latent means of fear of COVID-19 across groups and differences between t_1 and t_2 .

	Latent mean t_1 (SE)	Latent mean t_2 (SE)	Difference t_2-t_1
Group 1: vaccinated between t_1 and t_2	4.83 (0.07)	4.29 (0.07)	-0.54
Group 2: vaccinated before t_1	4.79 (0.11)	4.41 (0.11)	-0.38
Group 3: refusers	2.94 (0.16)	2.61 (0.16)	-0.33
Group 4: unvaccinated for other reasons	4.87 (0.20)	4.55 (0.21)	-0.32

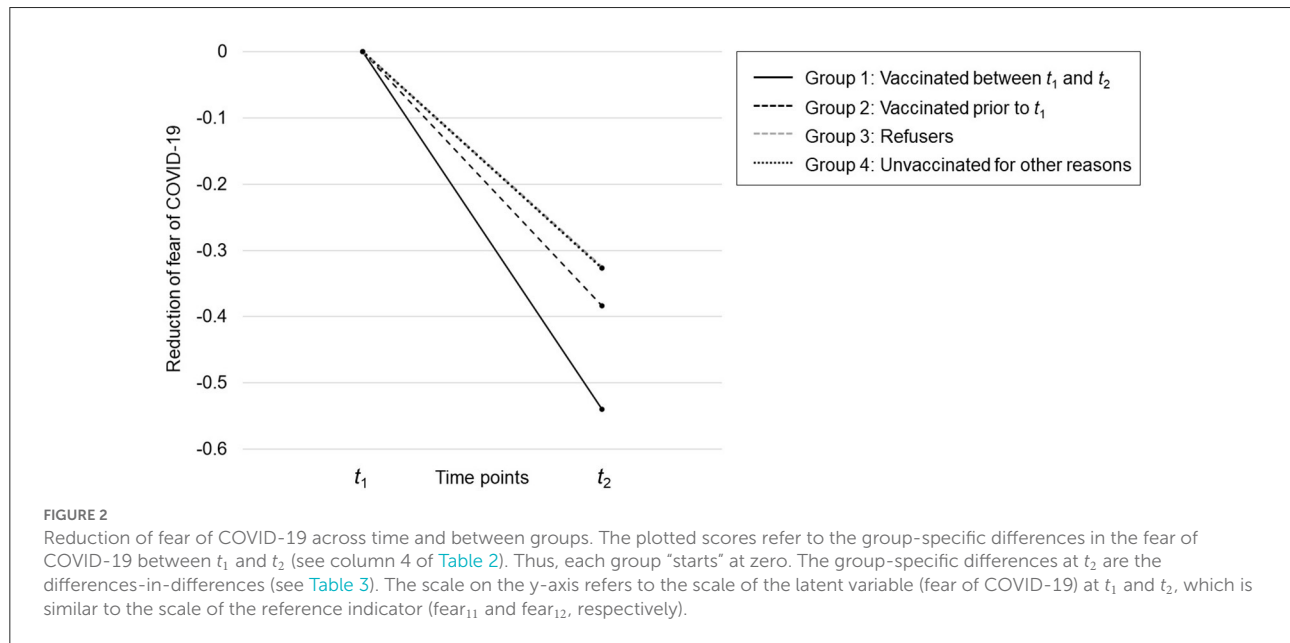
supporting hypothesis 1. Vaccination refusers (group 3) had the lowest level of fear of COVID-19 at t_1 , supporting hypothesis 2.

Moreover, fear of COVID-19 decreased across time in all groups. This may be attributed to a seasonal improvement of the situation in Germany between the two waves (25). However, the group-specific decrease was highest for individuals vaccinated between t_1 and t_2 (group 1) followed by individuals vaccinated prior to t_1 (group 2). The decrease in fear for refusers (group 3) and individuals unvaccinated at t_2 (group 4) was lowest.

The differences in the decrease of fear of COVID-19 across groups (i.e., the differences-in-differences) are presented in Table 3. The largest DiD was found between individuals vaccinated between t_1 and t_2 (group 1) and vaccination refusers (group 3). The DiD between individuals vaccinated between t_1 and t_2 (group 1) and unvaccinated at t_2 for other reasons (group 4) was similar. The DiD between vaccinated individuals between t_1 and t_2 (group 1) and individuals vaccinated prior to t_1 (group 2) was statistically significant. All other differences-in-differences were close to zero. This supports hypothesis 3 and suggests that people who received a vaccination benefitted not

TABLE 3 Latent mean differences-in-differences.

	Latent mean DiD (SE)	95% confidence interval	<i>p</i>
Group 1 vs. Group 2 (DiD ₁)	−0.16 (0.06)	(−0.27 −0.05)	0.01
Group 1 vs. Group 3 (DiD ₂)	−0.21 (0.07)	(−0.35 −0.08)	0.00
Group 1 vs. Group 4 (DiD ₃)	−0.21 (0.10)	(−0.41 −0.01)	0.04
Group 2 vs. Group 3 (DiD ₄)	−0.06 (0.08)	(−0.22 0.10)	0.47
Group 2 vs. Group 4 (DiD ₅)	−0.06 (0.11)	(−0.27 0.16)	0.60
Group 3 vs. Group 4 (DiD ₆)	0.00 (0.12)	(−0.23 0.23)	1.00



only from the vaccination protection but also in terms of their mental health, as their fear of COVID-19 decreased significantly and beyond the general downward trend (see also Figure 2).

While assessing the differences in the decrease of fear of COVID-19 across groups we controlled for age, gender, education, income, and immigration status. Some of the control variable effects on fear of COVID-19 were considerable in magnitude but not significant. For the sake of clarity, we only report coefficients with $p < 0.05$ (see the R output for the final model in the Supplementary material for details). People aged 60 or above in group 1 (vaccinated between t_1 and t_2) experienced higher fear of COVID-19 as did people with low income in group 3 (refusers). The standardized coefficients were 0.16 and 0.22, respectively. Males in group 1 (vaccinated between t_1 and t_2), group 3 (refusers), and group 4 (unvaccinated for other reasons) experienced less fear of COVID-19. The standardized coefficients were −0.25, −0.23, and 0.29, respectively.

Finally, we tested, in a separate model, if infection status may have influenced fear of COVID-19 at t_1 and t_2 (see Supplementary material). However, the data on infection status were inconsistent. For example, 29% of those who reported

at t_1 that they had tested positive, reported at t_2 that they had not been tested at all, tested but had no infection, or they did not know. Some respondents may have mistakenly answered this question thinking only about the time since the last interview. Regardless, using a dichotomized infection status dummy (yes/no) for t_1 and t_2 revealed no meaningful effects on fear of COVID-19 with one exception. People in group 1 (vaccinated between t_1 and t_2) had higher fear of COVID-19 after testing positive between t_1 and t_2 . This may have driven their decision to get vaccinated.

Discussion

Since the outbreak of the COVID-19 pandemic, people express their concerns and fears of negative health consequences, hospitalization, and dying from an infection. The fear of COVID-19 is associated with a plethora of negative mental health outcomes, such as psychological distress, post-traumatic stress symptoms, panic disorder, insomnia, anxiety,

and depression (1–4). When people experience fear of COVID-19, they are more likely to comply with regulations that are aimed at containing the virus such as getting a vaccination (5–7). In this study we examined whether getting vaccinated in turn leads to a reduction of the fear of COVID-19 that is measureable beyond a general (seasonal) trend. Since the summer of 2021, people in Germany had the opportunity to get vaccinated with different types of vaccines against COVID-19. While many were vaccinated between mid-April and late August/early September 2021, others were not because they refused or did not seek an appointment.

In the current study we explored whether and to what extent those vaccinated against COVID-19 experienced a decrease of fear of COVID-19, and if so, whether the decrease of fear was more evident as compared to others. We assessed study participants' vaccination status, fear of COVID-19, and background variables such as age, gender, education, income, and immigration status at two waves in April (t1) and August/September 2021 (t2). The study allowed the analysis of the data in a (quasi-experimental) "pre-post testing" design and to assess whether the mean level of fear of COVID-19 differed across time and between four groups: group 1—vaccinated between t1 and t2, group 2—vaccinated prior to t1, group 3—refusers, and group 4—unvaccinated for other reasons. Moreover, and most importantly, we tested whether cross-time differences within groups differed between groups by estimating differences-in-differences.

The results partly confirmed our first hypothesis. Many people with a high initial level of fear took the vaccine between t1 and t2 (group 1). However, a small proportion of people with similar initial levels of fear did not get vaccinated for reasons other than refusal (group 4). This group had the lowest mean age and the highest share of people with an immigrant background. Despite their concerns, younger people may not have felt the urgency to get vaccinated in the summer. In addition, access and acceptance barriers may have prevented people with an immigration background to get vaccinated (26).

The lowest level of fear was observed for vaccination refusers (group 3), which confirmed our second hypothesis. In line with recent studies, which indicate that higher education and being male is associated with positive vaccination intentions, this group had the lowest share of males and people with high education (27).

All groups experienced a reduction of fear between t1 and t2. However, the reduction of fear for people who were unvaccinated at t1 and received the vaccine between t1 and t2 (group 1) was significantly stronger than the fear reduction in all other groups, and in particular compared to the groups of refusers (group 3) and unvaccinated due to other reasons (group 4) (controlling for other factors, such as age, gender, education, income, and immigration status). This confirmed our third hypothesis. We interpret this as a positive effect of vaccination on the mental health condition of people who are concerned about the virus and not hesitant to get vaccinated.

Considering that the peak of registered infections appeared in March 2021, the perceived threat of the virus and the need for a vaccine may have led many—especially those who felt vulnerable—to consider getting vaccinated as soon as they had the opportunity. Getting vaccinated appears to have been at least a partial alleviation of the psychological distress caused by the pandemic.

Our study, however, has several limitations. First, it does not allow us to answer whether refusers would have experienced the same decrease, had they been vaccinated. Thus, we cannot tell if the fear-reducing effect of vaccination would have operated also on the refusers (group 3). Second, those who began with a higher level of fear (i.e., group 1—the vaccinated and group 4—people unvaccinated for other reasons) had a higher potential to experience a stronger reduction of fear compared to those who began with lower levels of fear (i.e., refusers) due to the so-called floor effect. However, this floor effect might have a limited impact given that we also observed a similar reduction in fear for the group with the lowest initial fear level (group 3) and the one with the highest initial fear level (group 4). Third, due to the sampling procedure and the use of quotas, we are reluctant to generalize our findings to the general population of Germany. However, the sociodemographic sample characteristics as well as the vaccination rates in the sample were similar to those of the official statistics of the German population for the time of the study, suggesting that the data represent the population reliably. Fourth, drawing causal inferences from the results also relies on the assumption that, in the absence of vaccination, the level of fear would have developed in the same way across groups (i.e., the common trends assumption) (17, 28). Testing this assumption requires at least one additional measurement occasion prior to t1 or field experimental conditions that are not possible to design, because it is not possible to randomly exclude individuals from the possibility to receive a vaccination. Fifth, and finally, many potential factors that may influence the general level of fear of COVID-19 or differences in fear between groups and time could not be controlled (such as fear of vaccination or stable personality characteristics).

Yet, and having these limitations in mind, the design of the study and our findings suggest that fear of COVID-19 is not only a driver of the decision to get vaccinated (29), but also that the vaccination effectively reduces fear beyond the general trend. Thus, this study supports the notion that vaccine development, deployment, and promotion programs are one of the most efficient societal investments in sciences and technologies (30). In public health communication we recommend that scientists, practitioners, and politicians highlight the positive effect of vaccination against COVID-19 in addition to protection against serious illness, hospitalization, and death. In addition, the policy implications resulting from our findings may be relevant beyond understanding the past and current situation in Germany but also for future occurrences. We hope that our findings enable societies and policy makers to better understand the *modus operandi* of response strategies of individuals, to

promote effective vaccines, and to enhance the willingness to get vaccinated by underlining that vaccines can reduce fear.

Transparency statement

The authors affirm that the manuscript is an honest, accurate, and transparent account of the study being reported. No important aspects of the study have been omitted.

Data availability statement

The data used in this study can be obtained from DS upon request. Anonymous individual participant data and a data dictionary can be obtained from the corresponding author upon request. Analytical codes are available in the [Supplementary material](#) submitted with the manuscript.

Ethics statement

The studies involving human participants were reviewed and approved by Ethics Committee of the Faculty of Management, Economics and Social Sciences, and University of Cologne (Reference Numbers: 210005DS and 210031DS). Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

DS: study and questionnaire design, data preparation, analysis, interpretation of results, writing, and proofreading. DM and ED: study and questionnaire design, interpretation of results, writing, and proofreading. All authors had access to and verified the validity of the data and results, 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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Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpubh.2022.878787/full#supplementary-material>

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How the emergence of the omicron variant may change people's attitudes toward the COVID-19 pandemic

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Background: This study aims to examine people's attitudes toward the COVID-19 pandemic before and after the emergence of the omicron variant.

Methods: Data were collected between November 15 and December 14, 2021, and three attitudes were included, namely, the negative influence on daily life, concerns of infection risk, and prediction of the ending of the pandemic.

Results: The majority of people perceived that daily life was at least somewhat negatively influenced by the COVID-19 pandemic, and they worried at least once a week about infection risk. After the emergence of the omicron variant, the perceived negative influence and concern of infection risk decreased slightly while the prediction of ending increased significantly. People who were infected by COVID-19 perceived more negative influence and more concern of infection risk, but were more optimistic about the ending of the pandemic. People who did not get a vaccine perceived less negative influence and less concern of infection risk, but were more pessimistic about the ending of the pandemic. The attitudes varied significantly by individual and contextual characteristics.

Conclusion: The emergence of omicron significantly increased people's predicted ending time of the pandemic but did not change people's perception of the pandemic's negative influence on daily life and concern of infection risk.

KEYWORDS

COVID-19 pandemic, omicron variant, negative influence on daily life, concerns of infection risk, prediction of the ending of the pandemic

Introduction

The ongoing COVID-19 pandemic impacts most, if not all, perspectives of our life. Despite the rollout of the COVID-19 vaccine, toward the end of 2021, the new cases per day were above 600 thousand and 100 thousand, globally and in the United States alone, respectively. The recently emerged omicron SARS-CoV-2 variant sparked another global

alarm. The omicron variant is a variant of the virus that causes COVID-19, first reported to the World Health Organization (WHO) on November 24, 2021 from South Africa. On November 26, 2021, the WHO classified it as a variant of concern (CDC, 2021). Having an unprecedentedly large number of mutations, the omicron variant may be more contagious than the original SARS-CoV-2 virus (Torjesen, 2021). Besides, for the omicron variant, we have limited knowledge of the severity of the disease and the effectiveness of prior infection, existing vaccines, and current treatment (WHO, 2021). Similar to the previous variants such as beta and delta, the emergence of the omicron variant is resulting in new waves of infection, although we are uncertain about the magnitude (Karim and Karim, 2021; Vaughan, 2021; Gao et al., 2022). After about 2 years of frustration with the pandemic, the emergence of the omicron variant may impact people's attitude toward the COVID-19 pandemic, for example, perception of the disturbance to our life, concerns of infection risk, and confidence about the pandemic control. To the best of our knowledge, few studies examined people's attitudes toward the COVID-19 pandemic, particularly the influence of the omicron variant. Such studies are important because these attitudes not only reflect people's view of the disease's contagiousness and severity but, more importantly, knowledge of their attitudes will contribute to the design and implementation of intervention measurements that could be tailored to certain groups.

The attitudes toward the pandemic may vary by individual's characteristics, reflecting not only the joint influence of multiple determinants from biological, social, economic, cultural, historical, and other perspectives but also the disproportional impact of the pandemic on some vulnerable groups (Mein, 2020; Webb Hooper et al., 2020). For example, minorities and groups with low socioeconomic status may have less access to healthcare resources, and thus, they may be more concerned about infection risk. People who were infected before may be more influenced by the pandemic, but may be less worried about their infection. The effect of COVID-19 vaccination may be less straightforward: vaccine uptake may decrease people's concern about their own infection risk, but at the same time, people who refuse to uptake the vaccine may be because they are less worried about the risk of infection. The attitudes may also be associated with contextual factors. People living in different neighborhood conditions (e.g., urban or rural with different poverty levels) may not only be impacted by the pandemic differently but also be exposed to different environmental changes through the pandemic. For example, evidence showed that neighborhoods with low poverty not only had more health-promoting conditions before the pandemic but also tended to have more positive changes during the pandemic (Yang and Xiang, 2021). Also, rural residents were less concerned about the pandemic and less supportive of the government's pandemic control measures

(Chauhan et al., 2021). To a larger spatial extension, various social norms and cultures may exist at both local and regional levels. In the United States, people's attitudes toward a vaccine and the control measures were largely different in different states. For example, in early December 2021, the ratio of adults who have at least one shot of the COVID-19 vaccine was 50% in Idaho compared with 88% in New Hampshire. Thus, understanding people's attitudes toward the pandemic and the influence of the omicron variant will also contribute to addressing the disparities of the pandemic's adverse effects.

This study aims to examine people's attitudes toward the COVID-19 pandemic before and after the emergence of the omicron variant with three measures, namely, the negative influence on daily life, concerns of infection risk, and prediction of the ending of the pandemic. It should be noted that the end of the COVID-19 pandemic does not mean there are no COVID-19 cases anymore; rather, the pandemic may change to some endemics similar to influenza, maybe with a seasonable pattern or maybe sporadic in some regions.

Methods

Respondents were recruited from Amazon Mechanical Turk (MTurk) (Keith et al., 2017), an online crowdsourcing platform. The survey was described as "a study aimed to understand how the coronavirus (COVID-19) outbreak has affected Americans' daily life and health." We collected participants' demographics, if infected by COVID-19 or not, the status of the COVID-19 vaccination, general physical health and mental health, and residential zip code. Data were collected between 15 November and December 14, 2021. The analysis was conducted in January 2022. The survey took about 2 min, and each participant was compensated \$0.20. The Institutional Review Board at the University of Memphis approved this study.

For the influence of the pandemic on daily life, we asked "During the past 30 days, to what extent did the pandemic negatively influence your daily life?" and respondents selected among five Likert scales ranged from "a great deal," "much," "somewhat," "little," to "never." For the concern of COVID-19 infection, we asked "During the past 30 days, how often have you worried about the possibility of getting a COVID-19 infection," and respondents selected among five Likert scales, namely, every day, a few days in a week, about once a week, seldom or less than once a week, and never. For the ending time of the pandemic, we asked "In your estimation, when will the COVID-19 pandemic end in the United States? by 'end,' we mean although there are still new infections emerging, these cases are largely under the control, and the spread of coronavirus looks similar to seasonal influenza," and respondents selected among seven options from "< 3 months," "≥ 3 and < 6 months," "≥ 6 and < 9 months," "≥ 9 and < 12 months," "≥ 1

and < 1.5 years,” “ ≥ 1.5 and < 2 years,” until “at least 2 years.”

Using participants' residential zip codes, we extracted three variables, namely, urbanicity (urban, suburban, rural) from the Rural-Urban Commuting Area Codes (U.S. Department of Agriculture, 2020), neighborhood poverty (i.e., the percent of families living below the poverty threshold) from the 2010 United States Census data, and the ratio of COVID-19 vaccination in each US state (i.e., the percent of people receiving at least one shot of COVID-19 vaccines) (USA Facts, 2021).

In this study, we used the day of November 26, 2021, when the omicron variant was classified as a variant of concern by the WHO (CDC, 2021), to separate participants as those who finished the survey before and after the emergence of the omicron variant. Weights were added to ensure the demographics of participants both before and after the omicron variant match with the United States general population using the 2020 Census considering gender, age, race/ethnicity, educational attainment, and household income. First, the three attitude outcomes were summarized both before and after the emergence of the omicron variant, with and without weights. Second, the mean value of each outcome was computed, stratified by the status of COVID-19 infection and vaccination, and before and after the emergence of the omicron variant. For the negative influence on daily life and concern of infection risk, the five Likert scales were coded into values from 1 to 5, with a higher value indicating a higher level of influence or concern. Similarly, the answer to the ending time of the pandemic was coded into values from 1 to 7, with a larger value indicating a long duration before the ending of the pandemic. Third, linear regressions were conducted to assess the association between the emergence of the omicron variant, the status of infection, and vaccination, with each of the three attitudes' outcomes, adjusted by individual demographics and contextual factors.

Results

As shown in Table 1, the whole sample included 3,239 participants, with 1,867 and 1,372 participants who finished the survey before and after the emergence of the omicron variant, respectively. The younger (18–24 years) and older adults (65 years and above), and those with low educational attainment were underrepresented in the sample. After weighting by demographics, the participants before and after the emergence of the omicron variant were roughly similar and matched the United States general population. The majority of participants lived in urban areas, in neighborhoods with moderate poverty, and in good and above physical and mental health status. About one-third of the participants were infected by COVID-19 and about 78% of them got the COVID-19 vaccine (at least one dose).

As Table 2 shows, with weights, 66% of participants perceived that their daily lives were at least somewhat negatively influenced by the COVID-19 pandemic before the omicron variant and the percentage decreased to 60% afterward, and the percent of those who worried at least once a week for the risk of infection was 54 and 50% before and after the omicron variant, respectively. Before the emergence of the omicron variant, about 57% of participants believed that the pandemic will end within a year and the percentage decreased to 50% after the omicron variant. The percent of those who believed the pandemic will not end within 2 years was 25% before the omicron variant and increased to 33% afterward.

As the subgroups by the status of COVID-19 infection and vaccination (see Table 3), compared with those who had not been infected, those who were infected by COVID-19 before perceived more negative influence and more concern of infection risk, but were more optimistic about the ending of the pandemic in general. People who got the vaccine had roughly similar outcomes compared with those who didn't get the vaccine but will get a vaccine. However, compared with those who got a vaccine, people who will not get a vaccine perceived much less negative influence and much less concern of infection risk, but were more pessimistic about the ending of the pandemic. In the comparison before and after the emergence of the omicron variant, most subgroups were consistent, that is, a slight or moderate increase in the perceived negative influence, a moderate decrease in the concern of infection risk, and the prediction of ending increased more significantly. Two subgroups are exceptional. First, the concern of infection risk was increased after the omicron variant among only one group: those who had not but will take a vaccine. Second, the prediction of ending was decreased after the omicron variant among only one group: those who will not take a vaccine.

As Table 4 shows, with the adjustment of several individuals and contextual variables, the emergence of the omicron variant was associated with a significant increase in the prediction of pandemic ending time and no change in the perceived negative influence and concern of infection risk. Hispanics, people with better physical health or worse mental health, those infected by COVID-19, and those who got COVID-19 vaccination tended to perceive a higher level of the negative influence of the COVID-19 pandemic on their daily life than their counterparts. Females, middle-aged adults, Hispanics, people with worse physical health or better mental health, those infected by COVID-19, those who got COVID-19 vaccination, and people living in states with a higher percent of vaccination tended to worry more frequently about COVID-19 infection compared with their counterparts. Females, younger adults, people with lower educational attainment or higher household income, those who had not been infected by COVID-19, and people living in suburban areas tended to be more pessimistic about the ending of the pandemic.

Discussions

The majority of people perceived that their daily life was at least somewhat negatively influenced by the COVID-19

pandemic, and they worry at least once a week about the risk of infection. The emergence of omicron variant significantly increased people's predicted ending time of the pandemic but did not change much of people's perception of the pandemic's

TABLE 1 Characteristics of participants.

Category	Item	Whole sample (<i>N</i> = 3220), unweighted	Before Omicron variant (<i>N</i> = 1862), weighted	After Omicron variant (<i>N</i> = 1358), weighted
Gender	Male	46.4	49.2	49.2
	Female	53.0	50.8	50.8
Age, in years	18–24	7.8	8.5	8.5
	25–34	40.7	17.0	17.0
	35–64	48.1	47.1	47.1
	65 and above	3.5	27.4	27.4
Race/ethnicity	White	65.4	60.3	60.3
	Black	10.7	13.4	13.4
	Asian	5.4	5.9	5.9
	Hispanic	16.6	18.5	18.5
	Other/mixed race	1.9	1.9	1.9
Educational attainment	High school or less	9.5	28.1	28.1
	Less than bachelor and more than high school	23.5	35.9	35.9
	Bachelor or higher	67.0	36	36
Household income	Less than \$24,999	16.3	18.1	18.1
	\$25,000–\$49,999	27.3	20.3	20.3
	\$50,000–\$74,999	25.7	17.4	17.4
	\$75,000–\$99,999	16.4	12.8	12.8
	\$100,000 or more	14.3	31.4	31.4
* Urbanization level	Urban	80.2	79	74.6
	Suburban	14.5	15.8	20.5
	Rural	5.3	5.2	5.0
Neighborhood poverty level	Low, ≤ 5%	10.4	8.0	12.9
	Moderate, > 5% - ≤20%	67.1	72.8	71.0
	High, > 20%	22.5	19.2	16.1
Physical health	Excellent	16.3	16.3	19.3
	Very good	34.8	32.1	31.6
	Good	35.8	37.8	30.8
	Fair	11.0	11.4	16.0
	Poor	2.1	2.4	2.2
Mental health	Excellent	13.0	18.6	15.2
	Very good	26.5	26.2	27.9
	Good	31.6	33.7	30.5
	Fair	21.2	15.1	20.2
	Poor	7.8	6.4	6.3
COVID-19 infection	Infected	33	31.2	33.0
	Has not been infected	67	68.8	67.0
COVID-19 vaccination	Yes	78.8	78.9	76.9
	No, but will do	8.6	7.6	6.7
	No, and will not do	12.6	13.5	16.4

The day of 26 November 2021 was used to separate participants as those who finished the survey before and after the emergence of the omicron variant. *The urbanization level was classified using the rural-urban commuting area (RUCA) codes (U.S. Department of Agriculture, 2020) from the home address' zip codes, as urban (RUCA code 1), suburban (RUCA codes 2–6), and rural (RUCA codes 7–10).

TABLE 2 The weighted distributions (%) of three perception outcomes, before and after the emergence of the omicron variant.

Before or after the emergence of the omicron variant		Before, N = 1862	After, N = 1358
Negative influence	A great deal	14.4	15.6
	Much	16.5	15.9
	Somewhat	35.1	28.4
	Little	23.6	31.7
	Never	10.5	8.4
Concern of infection	Everyday	18.9	16.1
	A few days in a week	20.0	18.4
	About once a week	14.7	15.3
	Seldom or less than once a week	29.2	33.0
	Never	17.3	17.3
Prediction of ending	< 3 months	10.4	8.5
	≥ 3 and < 6 months	14.2	11.0
	≥ 6 and < 9 months	14.7	12.0
	≥ 9 and < 12 months	17.7	18.9
	≥ 1 and < 1.5 years	10.4	10.9
	≥ 1.5 and < 2 years	7.8	6.4
	≥ 2 years	24.8	32.5

TABLE 3 The weighted percentages of participants who perceived their lives were negatively influenced by the COVID-19 pandemic, those who worried about COVID-19 infection frequently, and those who believed that there would be at least another year before the end of the pandemic, stratified by the status of COVID-19 infection and vaccine uptake.

Before/after the emergence of the omicron variant		¹ Negatively influenced		² Worried about infection		³ Pessimistic about the pandemic ending	
		Before	After	Before	After	Before	After
COVID-19 infection	No	27.3	27.6	33.8	30.5	46.4	55.3
	Yes	38.7	39.5	49.8	42.3	35.4	38.4
Vaccine uptake	Yes	32.3	32.8	44	38.7	41.7	48.9
	No but will	39.8	48.2	26.5	48.8	29.2	48.2
	No and will not	17.1	18.5	15.2	8.2	58.3	54.1

¹The percentage of participants who perceived the extent of the pandemic negatively influencing their daily life was either a great deal or much.

²The percentage of participants who worried about the possibility of getting a COVID-19 infection either everyday or a few days in a week.

³The percentage includes participants who estimated that it would take at least another year before the COVID-19 pandemic would end.

negative influence on their daily life and their worry about the risk of infection. This may be explained by the nature of the omicron variant (CDC, 2022; Wang et al., 2022): compared with previous variants such as beta and delta, omicron has less severe symptoms, and thus, people's worry about infection may not increase. At the same time, the omicron variant exhibits greater infectivity and thus may result in a new wave and prolong the pandemic.

Compared with those who had not been infected by COVID-19, infected people were more influenced by and more worried about, but were more optimistic about the ending of the pandemic. Infected people's relatively higher optimism may be due to their overcoming of the COVID-19 (at least these

participants survived and recovered largely, if not completely, from the disease). It may be not surprising to find that compared with those who got a COVID-19 vaccine, people who will not get a vaccine perceived less negative influence and much less worry about the pandemic because the perceived risk of disease is associated with the willingness of vaccination (Baumgaertner et al., 2020; Karlsson et al., 2021). Interestingly, for the group who had not but will take a vaccine, their worry about infection increased after the emergence of the omicron variant. This group may be not able or reluctant to get a vaccine for a while due to various reasons, and the highly contagious omicron variant may change their perception of the risk more compared with those who got a vaccine and those who will not get a

TABLE 4 Results of logistic regression models for the associations between variables with the three perception outcomes.

		¹ Negatively influenced	² Worried about infection	³ Pessimistic about the pandemic ending
The emergence of Omicron variant	Before (ref)	0	0	0
	After	1.02 (0.86,1.21)	0.89 (0.74,1.06)	1.25 (1.06,1.47)**
Gender	Male (ref)	0	0	0
	Female	0.92 (0.77,1.1)	1.44 (1.2,1.73)**	1.73 (1.46,2.05)**
Age, in years	18–24 (ref)	0	0	0
	25–34	0.65 (0.46,0.93)*	1.36 (0.93,2)	0.65 (0.46,0.92)*
	35–64	0.82 (0.6,1.12)	1.72 (1.22,2.43)**	0.67 (0.49,0.92)*
	65 and above	0.41 (0.28,0.59)**	0.57 (0.38,0.85)**	0.39 (0.27,0.56)**
Race /ethnicity	White (ref)	0	0	0
	Black	1.13 (0.86,1.49)	0.62 (0.46,0.83)**	1.13 (0.88,1.47)
	Asian	0.76 (0.52,1.12)	1.03 (0.72,1.49)	0.97 (0.68,1.39)
	Hispanic	1.47 (1.16,1.87)**	1.91 (1.5,2.43)**	0.46 (0.36,0.59)**
	Others	0.54 (0.27,1.09)	2.44 (1.31,4.52)**	0.41 (0.21,0.78)**
⁴ Educational attainment		0.94 (0.84,1.07)	1.1 (0.97,1.24)	0.7 (0.62,0.79)**
⁵ Household income		0.99 (0.93,1.06)	0.85 (0.8,0.91)**	1.13 (1.06,1.2)**
⁶ Physical health		0.74 (0.66,0.82)**	1.13 (1.01,1.26)*	1.13 (1.02,1.25)*
⁶ Mental health		1.29 (1.17,1.42)**	0.88 (0.79,0.97)**	1.1 (1.01,1.21)*
COVID-19 infection	No (ref)	0	0	0
	Yes	1.35 (1.11,1.64)**	1.61 (1.32,1.96)**	0.68 (0.56,0.82)**
COVID-19 vaccination	Yes (ref)	0	0	0
	No, but will	1.22 (0.88,1.67)	0.52 (0.37,0.73)**	0.82 (0.59,1.15)
	No, and will not	0.46 (0.35,0.62)**	0.18 (0.12,0.25)**	1.1 (0.87,1.4)
⁷ Urbanization level	Urban (ref)	0	0	0
	Suburban	0.82 (0.65,1.04)	0.62 (0.48,0.79)**	1.36 (1.1,1.69)**
	Rural	0.72 (0.46,1.11)	0.69 (0.45,1.07)	1.47 (1.2,1.6)
⁸ Neighborhood poverty level		1.05 (0.89,1.24)	1.1 (0.93,1.31)	0.88 (0.75,1.04)
⁹ State vaccination level		1.04 (0.93,1.15)	1.13 (1.02,1.25)*	1.1 (1,1.21)

Bold face indicates statistical significance, with * for $p < 0.05$ and ** for $p < 0.01$.

¹ Negatively influenced were participants who perceived that the extent of the pandemic negatively influencing their daily life was either a great deal or much.

² Worried about infection were participants who worried about the possibility of getting a COVID-19 infection either everyday or a few days in a week.

³ Pessimistic about the pandemic ending were participants who estimated that it would take at least another year before the COVID-19 pandemic would end.

⁴ Education attainment is coded into three levels, namely, 1 for high school and below; 2 for above high school and below bachelor; and 3 for bachelor and above.

⁵ Household income is coded into five levels, namely, 1 for less than \$24,999; 2 for \$25,000–\$49,999; 3 for \$50,000–\$74,999; 4 for \$75,000–\$99,999; and 5 for \$100,000 or more.

⁶ Both physical health and mental health are coded into five levels, namely, 1 for excellent; 2 for very good; 3 for good; 4 for fair; and 5 for poor.

⁷ Urbanization level is categorized using the rural–urban commuting area (RUCA) codes (U.S. Department of Agriculture, 2020) from the home address' zip codes as three levels, namely, (1) urban (RUCA code 1), (2) suburban (codes 2–6), and (3) rural (codes 7–10).

⁸ Neighborhood poverty level is coded into three levels, namely, 1 for $\leq 5\%$ of residents who were below the poverty line, 2 for $> 5\%$ and $\leq 20\%$, and 3 for $> 20\%$.

⁹ State vaccination level is coded into three levels, namely, 1 for $< 65\%$ of residents got at least one shot of COVID-19 vaccine, 2 for ≥ 65 and $< 75\%$, and 3 for $\geq 75\%$ until December 5, 2021 (USA Facts, 2021).

vaccine. Also, for the group who will not get a vaccine, their prediction of the pandemic ending decreased after the omicron variant. One possible explanation is that for this group who were unlikely to believe the effectiveness of the COVID-19 vaccine (Karlsson et al., 2021), the highly contagious omicron variant may speed up the natural immunity process, thus ending the pandemic earlier.

Our results confirmed that attitudes toward pandemics varied by some individual and contextual characteristics. For example, compared with male participants, female participants perceived a higher level of negative influence, more concerns

about infection, and more pessimism about the ending of the pandemic. This is consistent with some evidence that men tend to be more optimistic than women for various issues (Jacobsen et al., 2014; Bjuggren and Elert, 2019) and recent findings that women were disproportionately impacted (e.g., the burden of child care and more likely to lose employment) (Skinner et al., 2021; Zamarro and Prados, 2021) and tended to perceive and expect the COVID-19 pandemic more negatively than men (Dolinski et al., 2020; Alsharawy et al., 2021). Our results showed that middle-aged adults were more worried about the infection which may be due to the fact the middle-

aged adults tended to take multiple roles and they may be obligated to interact more frequently with the outside which may increase their exposure to the COVID-19 virus. Although we did not find significant differences in the negative influence on daily life by race/ethnicity (except Hispanic), education, and household income, our results indicated that higher household income was associated with less concern of infection risk, higher educational attainment was associated with being more optimistic for the ending of the pandemic, and worse mental health was associated with more negative influence by the pandemic.

As contextual characteristics, we did not find large differences in the negative influence and concern of infection risk across groups living in urban, suburban, and rural areas, although people who lived in suburban and rural areas were more pessimistic about the ending of the pandemic. Also contrary to our expectations, the neighborhood poverty level was not associated with negative influence although a higher neighborhood poverty level was associated with a higher concern of the infection risk. We found that living in states with a higher ratio of vaccination was associated with more concern of infection risk. A possible explanation is that people's higher concern of infection risk leads to a higher ratio of vaccination. Explaining each variation is beyond the aim of this study. For example, our results indicated that older adults were more optimistic about the ending of the pandemic, and Hispanics were more influenced by and more worried about, but were more optimistic about the ending of the pandemic. Further study is warranted for these interesting results.

One limitation of this study is that the sample is not a United States representative sample; although we added weights to match the sample with United States general population for major demographics, the online survey itself may exclude people who are illiterate or do not have access to the Internet. Second, taking advantage of a cross-sectional dataset that was collected between November and December 2021, we compared the attitudes toward the pandemic before and after the emergence of the omicron variant. Our findings may only reflect the immediate change of attitude, and more studies are needed to examine the influence of the omicron variant for a relatively long term, and longitudinal data will be ideal. Overall, our findings will help to design pandemic control and measurements, both mitigating the pandemic's adverse effects in general and reducing the disparities for certain groups.

Our findings may contribute to intervention measurements. For example, identification of the groups who were disproportionately negatively impacted by the pandemic such as females and younger adults may help to design tailored

interventions to mitigate the pandemic's adverse effects. Also, insights into people's concerns about infection risk could be leveraged to increase vaccination among some groups. For example, the worry of infection increased significantly after the emergence of the omicron variant among participants who had not but will take a vaccine. This indicates that the emergence of a new variant could be a unique opportunity to promote COVID-19 vaccination.

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 University of Memphis. The patients/participants provided their written informed consent to participate in this study.

Author contributions

YY conceived the study, collected related data, conducted analyses, and drafted the manuscript.

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Conflict of interest

The author declares 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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Pandemic Fatigue in Nursing Undergraduates: Role of Individual Resilience and Coping Styles in Health Promotion

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Introduction: The COVID-19 pandemic was soon declared a global health threat and had significant economic and health implications. Unprecedented government measures brought massive shifts in teaching-learning pedagogy in nursing to curb the infection. The study was conducted to explore the predictors of pandemic fatigue among nursing undergraduates and mediating role of individual resilience and coping styles during the third wave in India.

Methods: This online survey included 256 undergraduate nursing students studying at Tertiary Care Teaching Hospital in North India. Lockdown/Pandemic Fatigue Questionnaire, Brief Resilience Scale, and Coping Behavior Questionnaire were used to collect the information. Appropriate descriptive and inferential statistics were applied to compute the results.

Results: Nursing undergraduates reported a moderate level of fatigue during the restrictions imposed at the time of the third wave. Students' year of study ($p=0.001$), tested positive during pandemic ($p=0.003$), and post-COVID-19 hospitalization ($p=0.026$) were found associated with higher fatigue status. Advanced age ($p=0.046$) and higher personal resilience status ($p<0.001$) were associated with lower fatigue levels. Resilience status ($\beta=-4.311$, $p<0.001$) and second year of study ($\beta=3.198$, $p=0.015$) were reported as independent predictors of pandemic fatigue in students.

Conclusion: Findings suggest that lockdown-related fatigue was common in nursing undergraduates. Considering negative consequences on mental health, routine psychosocial screening of the nursing students should be conducted. Recommending stress-relieving measures should be enforced to help nursing undergraduates to combat lockdown-induced exhaustion.

Keywords: COVID-19, nursing, students, coping, resilience, fatigue

INTRODUCTION

The COVID-19 pandemic cases were detected in Wuhan in China's Hubei province for 2 years (Aslan and Pekince, 2021). The COVID-19 pandemic was declared a global threat and significantly impacted each area of life, including health and economics (Labrague and Ballad, 2021). Every government has taken unprecedented measures to control further transmission, including

mandatory lockdown, strict social distancing, frequent handwashing, and mandatory home quarantine or isolation after traveling to other parts or another country (Dharra and Kumar, 2021).

In India, the government imposed a countrywide lockdown and a partial lockdown named “night curfew” since the pandemic, forcing people to stay at home, reducing social interaction and physical activities, and leaving them with many psychosocial issues (Kumar et al., 2021). In addition, medical schools around the globe were also shut down before the pandemic reached on peak and left the students amid course completion dilemmas (Harries et al., 2021). However, government mitigating measures, including lockdown and social distancing, helped slow down the transmission of the virus but adversely affected the physical and psychological health and wellbeing of all categories of people, including nursing students (Labrague and Ballad, 2021).

Medical and nursing staff always take the forefront of any particular pandemic or outbreak and risk their lives. They are more prone and vulnerable to getting infection considering close contact with the infection, high stress, lack of rest, and extended duty hours in the hospital (Luberto et al., 2020). Extending course deadlines and duration might further intensify the stress and anxiety among nursing students (Huang et al., 2020). The changes in teaching-learning pedagogy and curriculum delivery of the nursing students might be expected to intensify students’ stress further. In addition, changes in the routine of academic, social restriction, and lifestyle behavior might negatively impact psychological wellbeing (Aslan and Pekince, 2021). Sadly, many health professionals lost their lives while providing care to patients with coronavirus at the hospital in the ongoing pandemic—every new strain of virus hammering the mental health of everyone and creating more panic among health professionals (Aslan and Pekince, 2021).

Resilience is a personality trait that helps an individual become strong and bounce back during a stressful situation or help to cope with adverse conditions (Hamadeh Kerbage et al., 2021). A higher resilience will help adapt to a stressful situation and help deal with mental, emotional, and educational challenges. Earlier literature reported the importance of resilience, ineffective adjustment, improving social relationships, social support, and psychological wellbeing (Yu et al., 2019). Indeed, resilience is considered one of the critical personality attributes affecting the retention of nursing students in their studies (Moloney et al., 2018).

Evidence shows that health professionals and university college students reported a higher incidence of psychological stress than the general population (Luberto et al., 2020). These students are more vulnerable to developing emotional problems, anxiety, stress, and depression considering fear of failure, time crisis, session duration change, exam pattern and timing, neglected self-care, and social restrictions to meeting family and friends (Dyrbye and Shanafelt, 2016; Yu et al., 2019). Huge uncertainties and confusion about the fixed deadline for the pandemic left the students with many questions related to their career selection and future (Agu et al., 2021). Still, there is no light on the other side of

dark tunnels, and experts speculate vividly to end this pandemic.

Therefore, there is a pressing need to explore predictors of pandemic fatigue and understand the mediating role of resilience and coping on health after 2 years of the pandemic in nursing undergraduates.

MATERIALS AND METHODS

Design, Sample, and Settings

This online cross-sectional survey was conducted after the end of the second wave of coronavirus in India when daily cases were reached below 10,000. At the same time, a new strain of COVID-19, Omicron, was knocking on the door to spread panic around the globe. The survey link was supplied with a consent form and asked each participant to provide consent before participating in the online survey. The survey questionnaire, Google Forms, was shared with 300 nursing students on the WhatsApp number of an individual nursing student, and 278 (92.66%) participants responded to the survey. Finally, after carefully scrutinizing the filled questionnaire, 256 questionnaires were deemed suitable for the analysis.

Instrumentations

Three structured and standardized questionnaires were used in the study. The Pandemic/Lockdown Fatigue Scale, the Brief Resilience Scale, the Brief Coping Questionnaire, and structured socio-demographics datasheet are used to collect personal and professional information from the participants.

Socio-Demographic Sheet

It consists of information on age, year of study, experience as a bedside nurse, being infected with COVID-19 virus and quarantine status and days, admission to hospital after getting an infection, and loss of family members due to COVID-19 infection. A group of microbiology, nursing, and infectious disease experts was requested to validate the profile. The inclusion items were based on more than 80% expert consensus for the items’ relevancy.

Pandemic/Lockdown Fatigue Scale

This scale was used to assess the exhaustion level among nursing students associated with frequent preventive measures like quarantine, home isolation, and other government-imposed guidelines to stop the spread of the transmission of the COVID-19 virus. It is a ten-item Likert scale ranging from 1 (never) to 5 (always) with a maximum possible score of 50. The scale has an excellent criterion validity and acceptable concurrent validity in earlier similar work (Michielsen et al., 2003; Labrague and Ballad, 2021). The scale’s internal consistency was measured using Cronbach’s alpha and was 0.84 for the present study. The scale content validation sought by the experts in microbiology, nursing, and internal medicine and scale rated relevant and appropriate for the interest of the population. The test-retest validity of the scale was 0.82 in the present study.

TABLE 1 | Students' characteristics ($n=256$).

Characteristics	Categories	N	Percentage
Year of study	II Year	88	34.3
	III Year	86	33.5
	IV Year	83	32.3
Exposure as a bedside nurse	Yes	101	39.3
	No	156	60.7
Tested COVID-19 positive	Yes	26	10.1
	No	231	89.9
Students hospitalized ^a	Yes	29	11.3
	No	229	88.7
A family member died ^a	Yes	15	5.8
	No	242	94.2
Quarantine status	Yes	202	78.6
	No	55	21.4
	Mean		SD
Age (years)		21.27	1.19
Personal resilience		3.02	0.42
Coping skills		18.73	5.60
Lockdown/pandemic fatigue scale		31.16	7.05

^aHospitalization and death due to COVID-19.

Quarantine (days) Mean (SD, range) 13.27 (2.93, 5–20).

TABLE 2 | Relationship of lockdown fatigue with characteristics of the students ($n=256$).

Characteristics	Categories	Mean SD	Value of p
Year of study ^a	II Year	33.48±6.65	0.001*
	III Year	30.16±6.84	
	IV Year	29.65±7.08	
Bedside exposure as nurse ^b	Yes	30.69±7.44	0.394
	No	31.46±6.79	
Tested COVID-19 positive ^b	Yes	35.04±7.35	0.003*
	No	30.72±6.89	
Hospitalization after COVID-19 ^b	Yes	37.00±6.08	0.026*
	No	30.99±7.01	
Family member hospitalized after COVID-19 ^b	Yes	32.69±6.24	0.215
	No	30.69±7.41	
Family Member died after COVID-19 ^b	Yes	34.40±6.60	0.066
	No	30.96±7.04	
Quarantine status ^b	Yes	31.51±6.81	0.127
	No	29.87±7.81	
	Test statistics		Value of p
Age (years) ^a		−0.125*	0.046*
Personal resilience ^a		−0.286	<0.001*
Coping styles ^a		0.161	0.010**

^aAnalysis of variance.

^bIndependent t -test.

^cPerson r correlation.

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

Brief Resilience Scale

The scale was used to determine the participants' ability to bounce back in unpleasant or difficult situations associated with pandemics and subsequent measures used to stop transmission during the pandemic. Students answered the scale by responding to a 5-point Likert scale ranging from 5 (describe me very well) to 0 (does not describe me at all). The scale is well validated in similar previous work (Smith et al., 2008;

Labrague and Ballad, 2021), and in the present study, the internal consistency value of the scale was 0.88. The scale's test-retest reliability was 0.89 in the present study.

Coping Behavior Questionnaire

The present study used a coping behavior questionnaire to measure the nursing undergraduates' coping measures during a mandatory lockdown or restriction period. The students were requested to respond to this eight-item 5-point Likert scale ranging from 5 (strongly agree) to 1 (strongly disagree). The scale shows excellent criterion validity and acceptable reliability in earlier work reporting an internal consistency value of 0.85 (Savitsky et al., 2020; Labrague and Ballad, 2021). In the current study, the scale's internal consistency was 0.83.

Ethical Considerations

The study was approved by the Institutional Ethics Committee (AIIMS/IEC/21/642). The survey link also provided a consent form as a mandatory requirement to participate. However, the participants were ensured to protect privacy and confidentiality at each data collection stage and dissemination of the findings. Further, no personal information was obtained to protect the privacy and confidentiality of the students.

RESULTS

In this online survey, 256 nursing undergraduates studied in a nursing college associated with a teaching hospital were included. The mean age of the students was 21.27 years, with a standard deviation of 1.19 years. All the students were female, considering the admission to female students in the institute. A more significant number of students were from the second year (34.3%), followed by the third year (33.5%) and fourth year (32.3%). Since there was no admission for the new batch due to an ongoing pandemic, there was no participation from the first-year students. 39.3% of students were deployed as bed nurses during the pandemic and had experience as bedside nurses in the hospital. 11.3% of students were hospitalized after testing positive for COVID-19 (10.1%) during the ongoing pandemic.

Further, more than three fourth of students underwent quarantine (78.6%), with a mean duration of 13.27 days of quarantine. Sadly, 5.8% of students lost one of their family members in the pandemic after getting COVID-19. The mean scores for the coping and personal resilience measures were 18.74 (SD: 5.60) and 3.02 (SD: 0.42), respectively (Table 1).

Table 2 shows the students' responses on the lockdown/pandemic fatigue scale. The mean fatigue scale score was 31.16 (SD: 7.05) out of the maximum possible score of 50. An independent sample t -test shows a significantly higher mean score ($p=0.026$) on the fatigue scale for students deployed as bedside nurses during the COVID-19 pandemic than another group. Likewise, students who tested positive during the pandemic reported significantly higher mean scores ($p=0.003$) than their counterparts. Further, it has been reported that second-year class students especially said higher fatigue scores ($p=0.001$)

TABLE 3 | Response to lockdown/pandemic fatigue scale ($n = 256$).

SN	Lockdown/Pandemic fatigue scale items	Agree [#]	Disagree [#]	Mean	SD	Rank
1	I worry a lot about my personal and family's safety during this pandemic.	236 (91.8)	10 (3.9)	4.25	0.80	1
2	I have felt sad and depressed as a result of the pandemic.	190 (74.0)	40 (15.6)	3.67	0.95	2
3	I frequently felt weak or tired as a result of the pandemic.	128 (49.8)	72 (28.0)	3.24	1.05	3
4	I have difficulty concentrating and am distracted easily.	124 (48.2)	92 (35.8)	3.16	1.14	5
5	I have been feeling irritable.	135 (52.5)	80 (31.1)	3.23	1.05	4
6	have difficulty falling or staying asleep over thinking about this pandemic.	71 (27.6)	147 (57.2)	2.58	1.10	10
7	I have been losing my interest to do the usual things I love.	73 (28.4)	150 (58.4)	2.60	1.15	9
8	I have been experiencing a general sense of emptiness	95 (37.0)	114 (44.4)	2.88	1.17	7
9	I have been experiencing headaches and body pains	80 (31.1)	153 (59.5)	2.61	1.20	8
10	I have thoughts that this pandemic will never end soon	106 (41.2)	105 (40.8)	2.95	1.10	6

[#]Agree (Agree + strongly agree) & Disagree (Disagree + strongly disagree).

TABLE 4 | Multiple linear regression on factors associated with pandemic fatigue ($n = 256$).

Variables	β	Beta	95% CI	t-value	Value of p
Constant	37.604		17.809–57.399	3.742	0.000
Age	0.137	0.023	–0.735–1.009	0.308	0.758
Coping	0.119	0.094	–0.030–0.268	1.569	0.118
Resilience	–4.311	–0.259	–6.216–(–2.406)	–4.457	<0.001*
Second year	3.198	0.215	0.619–5.779	2.443	0.015*
Third year	0.057	0.004	–2.039–2.152	0.054	0.958
Tested COVID-19 positive	2.613	0.112	–0.0477–5.703	1.666	0.097
Hospitalization after COVID-19	3.154	0.073	–2.549–8.857	1.089	0.277

β , Standard regression coefficient; CI, confidence interval; F , 7.170, $p < 0.001$, R square, 16.8%. *Value of $p < 0.05$.

than third and final-year students. This can be interpreted that higher class students might be experienced enough to handle patients in clinical after their earlier class experiences and hence reported lower fatigue scores compared to second-year students who are a novice and directly deployed to the clinical areas in a serious pandemic situation. Pearson's correlation coefficient showed a significant negative relationship between age ($r = -0.125$, $p = 0.046$) and personal resilience status ($r = -0.286$, $p < 0.01$), and lockdown fatigue. However, coping styles showed a positive relationship with lockdown fatigue ($r = 0.161$, $p = 0.010$; **Table 2**).

Findings revealed that a few of the items, 'I worry a lot about my personal and family's safety during this pandemic' ($m = 4.25$), 'I have felt sad and depressed as a result of the pandemic' ($m = 3.67$), and 'I frequently felt weak or tired as a result of the pandemic' ($m = 3.24$) reported more frequently by the participants. On the contrary, a few items that received lower attention were 'I have difficulty falling or staying asleep over thinking about this pandemic' ($m = 2.58$), 'I have been losing my interest in doing the usual things I love' ($m = 2.60$), and 'I have been experiencing headaches and body pains' ($m = 2.61$). Further, looking at the agreement status to fatigue items showed that 91.8% of participants responded that they are worried about personal and family members in the pandemic. Likewise, around two-thirds of the participants (74%) reported feeling depressed and sad during the pandemic, and more than half of the participants (52.5%) felt irritated by a pandemic or its related consequences (**Table 3**).

Variables that showed a significant association with lockdown fatigue were entered into the multiple linear regression model. The model explained 16.8% in the variance of the lockdown fatigue, which was statistically significant ($F = 7.170$, $p = < 0.001$), which indicated the model fit the variables. Out of inserted variables in the model, personal resilience and the second year of the study predicted lockdown fatigue among participants. This can be interpreted as those students who are studying in the lower class ($\beta = 3.198$, $p = 0.015$) and had poor resilience status ($\beta = -4.311$, $p < 0.001$) reported higher fatigue during the ongoing pandemic (**Table 4**).

DISCUSSION

The current digital survey was conducted to study the pandemic fatigue and the influence of nursing undergraduates' socio-demographic variables, coping styles, and resilience in mediating fatigue during the third wave of the COVID-19 pandemic between February and May 2021. The government has taken unprecedented measures to curb the further infection of different variants of the COVID-19 virus from time to time. Further, the authors presumed that the sudden shifting of traditional classroom teaching and clinical learning to virtual learning coupled with home or hostel confinement and reduced physical activities during the COVID-19 pandemic might lead to more fatigue in nursing students (Liu et al., 2021). In the certain phase of the pandemic, nursing students are confined in the

hostel or wherever they are, which further intensifies many psychological problems, including anxiety, depression, and fatigue (Brooks et al., 2020). Heavy clinical load, daily infection precautionary measures at work and hostel, reduced social connections, and social distancing could lead to mental fatigue, anxiety, frustration, and boredom (Brooks et al., 2020; Chao et al., 2020; Morales-Rodríguez, 2021).

Participants' mean fatigue score was 31.16 (SD: 7.05), indicating moderate fatigue status during the ongoing pandemic. A crunch of studies used the lockdown/pandemic fatigue scale; hence, authors find it challenging to compare these findings. However, our study results are in line with a study conducted (Labrague and Ballard, 2021) at Muscat, Oman, on college students who used the pandemic fatigue scale (PFS) reported a similar level of fatigue (31.54; SD: 6.93) during the pandemic. Further, a Chinese study (Liu et al., 2021) reported that more than 67.3% of nursing students said fatigue which is almost doubled (36%) to work conducted (Geiger-Brown et al., 2012) on nurses working in different shifts using the Occupational Fatigue Exhaustion Recovery Scale. Our findings are in consensus with the work (Teng et al., 2020), who reported fatigue in 73.7% of frontline healthcare workers during an initial COVID-19 outbreak in China as measured by the Fatigue Self-Assessment Scale (Teng et al., 2020). These results further follow another work from Australia; a few months after lockdown, the Chalder Fatigue Questionnaire reported a significant level of fatigue (Nitschke et al., 2021). Shreds of evidence from the United States, Saudi Arabia, and India report a substantial amount of tiredness, and increased fatigue, boredom, worry, and loneliness, suggesting some efforts to support the affected population to combat the adverse effect of prolonged lockdown, confinement, and other confinement measures imposed by government time to time (Majumdar et al., 2020; Meo et al., 2020). In contrast, medical students' fatigue status was relatively low (13.8%) before the COVID-19 outbreak (Abdali et al., 2019). Owing to different measurement tools on fatigue between different studies across the globe indicates cautious interpretations and extrapolating of the findings. Considering the negative impact of fatigue on the individual's physical, mental, cognitive, and behavioral functions (Trendall, 2000), it is imperative to devise support or other stress-relieving strategies to benefit mental health.

The symptoms of fatigue among nursing undergraduates, lack of concentration, irritation, disturbed sleep, feeling depressed and emptiness, and tired are other symptoms reported by the students. These symptoms are in line with the earlier Indian work conducted on professionals and students who reported various indicators of symptoms, including anxiety, higher stress, feeling of sleeplessness, depression, a safety concern for family, tiredness, and worry for personal safety and other physical discomforts, during the lockdown (Majumdar et al., 2020). The reported fatigue symptomatology in this study was similar to the report of the symptoms presented by Australian Psychological Society (2020), which reported a loss of interest in previously enjoyed activities, physical exhaustion, fear, anxiety, emotional outburst, reduced motivation, depression, and difficulty in focusing and problem-solving as a typical array of symptoms of lockdown fatigue.

Students' year of study, COVID-19 positive status, and post-COVID-19 hospitalization directly impacted the development of lockdown fatigue. In particular, final-year and third-year students reported lower lockdown fatigue than second-year students. These findings are anticipated, as, during the study, students will be exposed to different clinical conditions and environments to develop positive temperament and adaptive behavior to work with different kinds of patients, which help a student to further deal with such kind of disastrous conditions (Benner, 2004; Sonika and Kumar, 2019). The present study's findings of lower stress among the higher level of education are also in consensus with the previous studies conducted on nursing students (Kumar and Nancy, 2011; Dharra and Kumar, 2021). Furthermore, previous work on stress among nursing students showed a declining trend as they progress to higher studies, similar to the present report (Kumar and Nancy, 2011; Fornés-Vives et al., 2016). These findings of higher stress in lower-class students indicate developing an evidence-based support system through evidence-based intervention to assist budding nurses in developing coping strategies and adaptive resilience to deal with such disastrous situations effectively.

Further, regression analysis findings showed a significant negative association of personal resilience with lockdown fatigue, suggesting a protective role of individual resilience against the negative consequences of restrictions faced during mandatory home isolation or quarantine during the pandemic. These study findings align with the earlier work that reported a significant negative relationship between personal resilience and lockdown fatigue in college students (Labrague and Ballard, 2021). Close similar findings presented in earlier work reported a positive impact of personal resilience on improving mental health and psychological outcomes among different populations around the globe (Tsay et al., 2001; Charuvastra and Cloitre, 2008; Ran et al., 2020). The study findings draw the mentor and teachers' attention to building resilience as a strategy to help a student bounce back from such adversity and traumatic situations. To our current knowledge, this is the first of its study in the area, highlighting the impact of individual resilience and coping styles on combating negative consequences on mental health associated with a pandemic, hence supplementing the existing knowledge in this area of research.

Students who used higher coping styles showed higher lockdown fatigue in the current study. Previous studies on nursing students also have identical findings for a significant correlation between fatigue and nursing students' coping (Nurhidayati et al., 2021). Likewise, another study reported a significant relationship between coping mechanisms and fatigue, suggesting a positive impact of coping mechanisms on fatigue during adverse situations (Michalec et al., 2013). In contrast, the findings on the relationship between coping and fatigue are in non-accordance with many previously published studies that reported a negative relationship between coping mechanisms and fatigue (Tugade and Fredrickson, 2004; Cao et al., 2020; Tull et al., 2020). These contentious findings on coping and fatigue provide additional knowledge to understand the precise

mediating effect of coping mechanisms in acute and chronic adversity, including the current pandemic. Instead, higher coping use in students might help reduce fatigue and other mental health issues, including irritation, sleeplessness, distraction, sadness, and body aches compared to students not or less use of coping strategies as mentioned in earlier research (Labrague and De los Santos, 2020; Labrague, 2021; Roberts et al., 2021). However, authors speculate the use of a different tool and longer duration of a pandemic for such unforeseen results on the relationship between coping and fatigue. However, it is vital to devise strategies to improve resilience and coping mechanisms among nursing students to maintain and improve their mental health and overall psychological well-being.

Limitations

The study should be appraised under many limitations, and other researchers should be cautious while interpreting and extrapolating the results. First, the cross-sectional nature of the survey impedes computing the exact relationship between different variables, including fatigue, coping, and resilience. It is difficult to interpret from the study that higher resilient and coping mechanisms students have lesser fatigue during the lockdown in comparison to counterparts. Hence, the authors recommend using different study designs, including randomized controlled trials or case-control studies, to understand the mediating effect of resilience in improving fatigue and coping skills in students. Second, a study with a higher sample size is recommended to enhance generalizability over other similar populations. Third, online surveys carry inherent bias, including social-desirability bias, and need caution to interpret the findings.

CONCLUSION

As per the findings, lockdown-related fatigue was common in nursing undergraduates during the third wave of the COVID-19. Further, the junior students reported tested positive and were hospitalized during the pandemic reported higher fatigue than their counterparts. The study reported that senior students with higher resilience levels said lower fatigue, indicating the significance of perceived professional self-confidence and the need for preparation and precautions to take in a disease outbreak. These findings also reflect the necessity of developing

junior students' professional competencies and patient handling. However, a structured curriculum and adequate clinical exposure will train the students in developing professional competencies and patient handling skills.

Implications for Nursing Management

Nursing students face enormous challenges during the ongoing pandemic, including the transition of teaching-learning pedagogy, deployment in different levels of clinical assignment, and many other personal and professional obligations. Individual resilience helps beat the negative consequences of pandemic fatigue in nursing students. Nursing educators should prioritize proactive measures to reduce pandemic-induced fatigue and strengthen personal resilience among students. Resilience promotional strategies could be an alternative intervention to improve more use of positive coping strategies to enhance the mental health promotion of nursing students.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation on a individual request of a researcher to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Ethics Committee, All India Institute of Medical Sciences, AIIMS Rishikesh. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

RK considered and designed the study, conducted research, provided research materials, and collected and organized data. KB wrote the initial and final draft of the manuscript and provided logistic support. YB analyzed and interpreted data and did the final editing. All authors contributed to the article and approved the submitted version.

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Pathway linking health information behaviors to mental health condition during the COVID-19 infodemic: A moderated mediation analysis

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Background: The COVID-19 outbreak is no longer a pure epidemiological concern but a true digital infodemic. Numerous conflicting information and misinformation occupy online platforms and specifically social media. While we have lived in an infodemic environment for more than 2 years, we are more prone to feel overwhelmed by the information and suffer from long-term mental health problems. However, limited research has concentrated on the cause of these threats, particularly in terms of information processing and the context of infodemic.

Objective: This study proposed and tested moderated mediation pathways from two types of health information behaviors (social media engagement and interpersonal communication) on information overload and mental health symptoms—long-term stress.

Methods: We conducted a cross-sectional online survey between May and June of 2021 among the Malaysian public. The final sample size was 676 ($N = 676$). A conceptual model was built to guide the data analysis. We conducted structural equation modeling (SEM), moderation and mediation analyses to examine each direct pathway, moderating and mediating effects.

Results: According to the pathway analysis, we found that, during the infodemic period, engaging COVID-19 information on social media positively associated with information overload, but interpersonal communication was negatively related to it. As the proximal outcome, there was also a positive association between information overload and the final outcome, perceived stress. The moderation analysis only reported one significant interaction: risk perception weakened the association between social media engagement and information overload. A conditional indirect effect was demonstrated and the indirect associated between social media engagement and perceived stress mediated through information overload was further moderated by COVID-19 risk perception.

Conclusion: This research offers new grounds for understanding health information behaviors and their consequences in the COVID-19 infodemic. We particularly highlighted the distinct functions of health information behaviors in causing information overload, as well as the importance of personal health belief in this process. Our proposed model contributes to the strategies of developing health messaging strategies that may be utilized by public health researchers and health educators in the future.

KEYWORDS

COVID-19 infodemic, information overload, health information behaviors, risk perception, mental health condition, Malaysia

Introduction

It has been more than 2 years since the Coronavirus disease (hereafter COVID-19) firstly detected in Wuhan, a metropolitan city in central China, in December 2019. Since then, information channels, such as mass media, social media and interpersonal communication, have been instrumental in informing the public about the up-to-date situation of COVID-19, enhancing their knowledge, awareness, and prompting their preventive intentions toward the disease (1, 2). Technological changes on health information delivery systems such as social media are capable of disseminating health messages instantly during this time. For instance, one recent study found that consuming COVID-19 information on WeChat, Weibo, and TikTok mobilizes the Chinese citizens' intention and practice on precautionary measures (3, 4). In the US, information behaviors on social media also help the public develops the intention of wearing a facemask in public places (5).

Despite the documentation on the benefits of social media use during the pandemic, its utilization can create new problems. In response, the World Health Organization (WHO) has indicated that COVID-19 is accompanied by a true social media infodemic, as information and misinformation about the disease spreads online (6). The phenomenon of infodemic is evident in the online environment, where misperceptions toward the virus, politicalized contents regarding preventive measures, conspiracy theories, and manipulated anti-vaccination messages are widely spread without censors (7, 8). Therefore, examining relevant information behaviors and consequences in the context of infodemic is of paramount importance.

Study rationale and hypotheses development

When infodemiological consideration becomes a severe side effect of the COVID-19 pandemic, many related problems emerged (7, 9). One prominent issue attracting scholarly

attention is information overload (IO) (10), a situation where individuals feel overwhelmed and confused about a specific health topic after being inundated with an informational mixture containing verified and unverified health information from various sources (11). Previous studies have revealed that IO is one of the negative consequences of health information engagement (12). It occurs when individuals fail to process newly obtained health information as the information environment is full of confused, heterogeneous, and misleading contents (13). If individuals suffer from IO, as a result, their knowledge acquisition, quality of life, and mental health are very likely to be affected (11, 14, 15).

The conceptualization and theorization of IO in public health remains unclear despite ample studies examining its role in studies on cancer (11, 16), nutrition (17), and the COVID-19 pandemic (18, 19). First, previous studies fail to include IO as a limitation of message processors in the information process (19). These studies only examined the relationship between IO and demographical and psychosocial factors, such as family cancer history, anxiety, and sadness (11, 17). Meanwhile, the operational definition of IO in existing studies is equivocal. Some studies considered IO as a result of media usage (20), whilst others recognized IO as an existing "environmental stimulus," thus linking IO with psychological reactions or an immediate consequence (e.g., information avoidance) (10, 19, 21). Hence, ambiguities concerning the concept's content and boundaries as well as measurement problems limit cumulative theory building and easy adaption in health communication. In this study, we proposed that the understanding of IO should adhere to the most forthright reasoning in information processing: Someone may suffer from IO after engaging the relevant media content (12) rather than presuming he or she is immersed in an overwhelmed information environment. Consequently, we focus on the information engagement on social media, while linking social media engagement to IO as a proximal outcome and perceived stress as one prominent long-term mental health condition during the COVID-19 infodemic, as the final outcome (22).

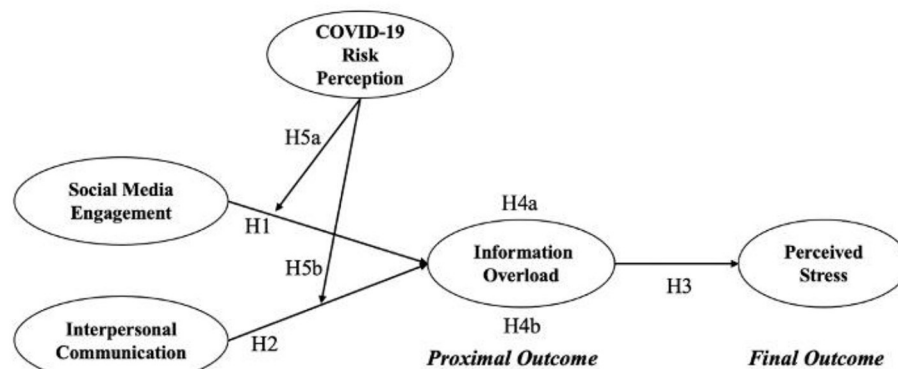


FIGURE 1
Conceptual model.

We also included interpersonal communication as another information-gathering strategy for acquiring health information, as it is defined as a critical information behavior during a pandemic (2, 23). In this study, interpersonal communication refers to the real-time and face-to-face discussions for obtaining COVID-19 health information. During the time of the infodemic, individuals already have too much conflicting informational input during their daily social media usage. When they communicate COVID-19 issues with their family, friends and other social networks, their likelihood of experiencing IO would be higher since the information obtained from interpersonal networks is seemingly conflicting. The trustworthiness and credibility of obtained information somehow cannot be ensured. For example, a study in South Korea during the earlier stages of the outbreak reported that communicating COVID-19 topics with family, friends and co-workers positively triggered the likelihood of IO (20). Therefore, we propose the following hypotheses:

H1: Social media engagement is positively associated with information overload.

H2: Interpersonal communication is positively associated with information overload.

Regardless of how previous studies defined IO, the majority demonstrated that IO is associated with immediate responses, such as information anxiety (24) and intentions to reject further information (10). However, they ignored the predictive power of IO on long-term psychological or health outcomes. As the impact of health information acquisitions on long-term mental health symptoms becomes a critical concern during the COVID-19 outbreak (25), it is reasonable to examine the patterns of individuals engaging in health information and the implications in an infodemic environment. Especially, since this infodemic has persisted for over 2 years, individuals feel overwhelmed with the wealth of information on COVID-19 surrounding them, causing stress and contributing to pandemic fatigue. A

recent study found that stress-related contents were more likely to be expressed than worry- and fear-related ones after April 2020 on the COVID-19 Twitter posting trend (22). Therefore, governments and medical authorities have begun to educate the public on preventative measures, publish scientific reports, as well as plan and implement vaccination programs that can serve as uncertainty reducer for individuals (26). They were less likely to feel worry and fear, but more likely to be stressed in the long run. Considering this, we include stress as a health outcome and hope to learn how information processing during the infodemic contributes to this mental health condition. Since IO is caused by information consumption and predicts several other outcomes (12, 27), it is concomitantly essential to consider IO as a mediator between information behaviors and health outcomes. Therefore, the following hypotheses are proposed:

H3: Information overload is positively associated with perceived stress.

H4: Information overload positively mediates the association between (a) social media engagement, (b) interpersonal communication, and perceived stress.

Furthermore, apart from understanding health IO and subsequent mental health outcome in the COVID-19 infodemic through the linear fashion, the mechanisms of mediated communication in public health settings are much more complicated and dynamic. From the theoretical aspect, the ecological model of communication (28) depicts that the process of public health communication or health-related media usage involves influences from various contextual factors including personal, interpersonal, organizational, and societal or cultural levels. Interplays between these contextual factors and communicative actions could jointly affect health outcomes (29). The contextual factors are broad, complex, and multidimensional (30). Therefore, it is beyond the objective of this study to comprehensively review moderators on the pathways between information behaviors and IO. We select

TABLE 1 Demographic information of the respondents ($N = 676$).

Demographic factors		<i>n</i>	%
Gender	Male	296	43.8%
	Female	380	56.2%
Age	Mean: 32.87, SD: 10.60		
Ethnicity	Malay	327	48.4%
	Chinese	269	39.8%
	Indian	28	4.1%
	Non-muslim bumiputra	52	7.7%
Religion	Buddhism	148	21.9%
	Christianity	135	20.0%
	Islam	334	49.4%
	Taoism & traditional	33	3.3%
	Chinese beliefs		
	Hinduism	24	3.6%
Education	Non/Atheism	13	1.9%
	Primary school	1	0.1%
	Secondary school	45	6.7%
	High school	47	7.0%
	Diploma	122	18.0%
	Bachelor's degree	368	54.4%
Staying status	Postgraduate degree	93	13.8%
	Metropolitan area	308	45.6%
	Urban area	273	40.4%
	Rural area	95	14.1%

risk perception as an example of contextual influences, as many empirical studies in different public health contexts accentuated that personal health beliefs, especially perceived likelihood, severity, seriousness, and susceptibility regarding a health threat (all under the terminological umbrella of “risk perception”), are predominant psychological factors that affect individuals’ preventive intentions and coping behaviors, including health information acquisition (31, 32). Although considering risk perception as a contextual factor in the COVID-19 infodemic context is rare, especially its influence on the process of causing IO, logical reasoning facilitates our arguments. Risk belief related to the COVID-19 pandemic can impact health information processing, either by strengthening or weakening the association between information behaviors and the outcomes. Individuals who believe their chances of getting COVID-19 and those around them are high may have a better awareness of the pandemic and are more familiar with

TABLE 2 Descriptive statistics and confirmatory factor analysis (CFA) of measured variables.

Item name	Mean	Median	SD	Factor loading
<i>Social media engagement</i> ($\alpha = 0.85$)	5.37	5.50	0.76	
SME1				0.79
SME2				0.71
<i>Interpersonal communication</i> ($\alpha = 0.76$)	4.42	4.50	0.96	
IC1				0.70
IC2				0.82
IC3				0.75
IC4				0.46
<i>COVID-19 risk perception</i> ($\alpha = 0.93$)	5.12	5.71	0.89	
RP1				0.86
RP2				0.88
RP3				0.83
RP4				0.84
RP5				0.82
RP6				0.80
RP7				0.66
<i>Information overload</i> ($\alpha = 0.91$)	5.44	5.40	0.66	
IO1				0.82
IO2				0.84
IO3				0.80
IO4				0.84
IO5				0.83
<i>COVID-19 stress</i> ($\alpha = 0.84$)	4.84	5.00	1.07	
Stress 1				0.84
Stress 2				0.87

the most recent information on preventive measures than those who believe they are not at danger. In the same vein, high perceived risk individuals are keener to use the information they have obtained and accessible health services to evaluate the current situation, make health decisions, and take preventive measures. It is reasonable to say that individuals with sufficient risk perceptions are less likely to feel overwhelmed, fatigued, and experience other adverse outcomes than their counterparts after frequently consuming COVID-19 information from different channels. This proposition echoes Street’s (28) ecological model regarding the moderating role of self-related health concepts, such as attitudes and beliefs. Besides, it is also worth noting that our study is not the first to offer this logical thought. For other health issues, a study focusing on the MERS outbreak in South

Korea reported that risk perception strengthens the relationship between health information seeking and preventive behaviors practices (33). Regarding cancer issues, Zhuang and Guan (34) also found that risk perception moderates the association between previous cancer information seeking experiences and breast cancer screening among female Americans. As such, we propose the following:

H5: COVID-19 risk perception negatively moderates the positive association between (a) social media engagement, (b) interpersonal communication, and information overload.

Considering risk perception moderates the positive association between COVID-19 health information behaviors and IO, it is also feasible to propose that risk perception could conditionally bring effects to the indirect pathway from information behaviors (antecedents) to perceived stress (outcome) through IO (the mediator and proximal outcome). Therefore, we postulate:

H6: COVID-19 risk perception negatively moderates the indirect effect of (a) social media engagement and (b) interpersonal communication on perceived stress through the mediating role of IO.

Taken all together, a pathway model is conceptualized (Figure 1).

Methods

Data collection

A cross-sectional survey was conducted from May to June 2021 in Malaysia after obtaining ethical approval from the authors' affiliated institution [UPM/TNCPI/RMC/JKEUPM/1.4.18.2 (JKEUPM)], when the country was under a full lockdown. We used a set of online questionnaires in three versions to recruit respondents (i.e., in English, Malay, and Chinese; the three main languages Malaysians use). Due to the safety measures announced by the government during the lockdown, we were unable to collect data through physical ways. Thus, we generated the survey items into Google Form and then distributed the links on authors' different social media platforms. Participants were recruited by distributing a one-page recruiting message to community leaders and social media influencers in the authors' Facebook, Twitter, Instagram, and WhatsApp groups. In the recruitment message, we included a brief introduction to the study's purpose, data collection procedures, the voluntary nature of participation, declarations of anonymity and confidentiality, and notes for filling out the questionnaire, as well as links to English, Malay and Chinese language versions of the online questionnaires.

All respondents were above 18 years old and therefore involved no minors. The study participants were given no incentive for their participation. Participants gave consent to willingly participate in the survey by clicking the "continue"

button, which would direct them to complete the self-administered questionnaire. After employing convenience and snowball sampling methods concurrently, a total of 776 surveys were initiated. Only surveys that were missing <10% of data were retained (35). Hence, we included a total of 676 responses in the final analysis. The description of demographic information is shown in Table 1.

Measurement

The survey questionnaire used in this study contained six sections, including measured variables in the conceptual model and demographic information. A total of 20 items were involved in measuring five constructs in the conceptual model. We used a 6-point scale to measure each item. The questionnaire in English can be accessed in [Supplementary material](#).

Antecedent factors

Social media engagement, one of the health information behaviors, was measured by two items ranging from 1 (not at all) to 6 (very much) (36), which are "How often did you receive/express COVID-19 information on social media platforms (e.g., Facebook, Twitter, Instagram, WhatsApp, Telegram, WeChat) during the last 7 days?" To treat this as a continuous variable, all items were summed and averaged to create a composite score, with a higher score indicating a higher level of social media engagement ($\alpha = 0.85$, $M = 5.37$, $SD = 0.76$).

Interpersonal communication as another health information behavior to obtain COVID-19 information was measured by four items (1 = not at all to 6 = very frequently), adopted from Ho et al. (2). Four interpersonal information sources were family members, friends, colleagues, and healthcare providers. We averaged the responses and created a composite score. Higher score indicates a higher frequency of discussing COVID-19 topics with interpersonal networks ($\alpha = 0.76$, $M = 4.42$, $SD = 0.96$).

Proximal outcome factor

IO was served as the proximal outcome and mediator in our conceptual model. Its measurement included five items (ranging from 1 = strongly disagree to 6 = strongly agree) which was adopted from Costa et al.'s (37) simplified Cancer Information Overload Scale (13). We replaced "cancer" with "COVID-19" in the items. The responses were summed up and averaged, with higher score showing higher level of IO ($\alpha = 0.91$, $M = 5.44$, $SD = 0.66$).

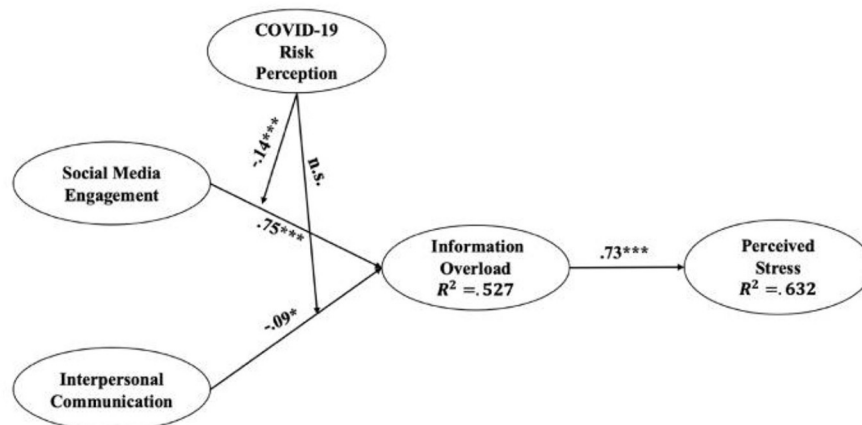


FIGURE 2

Conceptual model after analysis. *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$.

Final outcome factor

The final outcome variable in the conceptual model is the long-term mental health condition, perceived stress. It was measured with two items on a 6-point scale ranging from 1 (strongly disagree) to 6 (strongly agree) (38). These were (1) “Currently, I feel so down in the dumps that nothing could cheer me up” and (2) “Currently, I feel downhearted and blue.” All responses were summed and averaged to create a single index, with higher score indicating higher stress level ($\alpha = 0.84$, $M = 4.84$, $SD = 1.07$).

Moderating factor

As a type of personal health belief, COVID-19 risk perception served as a moderator in the conceptual model. This instrumentation was guided by Dryhurst et al. (39). Seven items were included using a 6-point scale, ranging from 1 (strongly disagree) to 6 (strongly agree). These items included subdimensions under the concept of risk perception, such as perceived seriousness, perceived severity, perceived susceptibility, and comparative risk belief at the individual, societal and global levels. We summed and averaged these seven items to consider it as continuous, with a higher score representing higher risk perception ($\alpha = 0.93$, $M = 5.12$, $SD = 0.89$).

Data analysis

We performed two statistical methods to analyze the conceptual model, structural equation modeling (SEM), as well as moderation and mediation analysis in PROCESS macro. First, the pathway analysis was conducted using SEM through lavaan package in R. In the structural model, two

types of information behaviors, social media engagement, and interpersonal communication, were considered exogenous variables, the proximal outcome, IO, and the final outcome perceived stress were endogenous variables. Demographic variables such as gender, age, ethnicity, religion, and education level were treated as control variables. We used maximum likelihood estimation to examine the pathway coefficients of the hypothesized model. To establish the proposed model and evaluate its fit, the following criteria were considered: (1) relative chi-square (χ^2/df), (2) comparative fit index (CFI), (3) Tucker–Lewis index (TLI), (4) root mean square error of approximation (RMSEA), and (5) standardized root mean square residual (SRMR). If the model has a good statistical fit with the data, the value of the relative chi-square should fall between 1.0 and 5.0, and the CFI and TLI values need to be higher than 0.95, RMSEA should be close to 0.06, and SRMR values should be less than 0.08 (40).

Additionally, we used the PROCESS macro in R to examine simple mediation (H4) and moderation (H5) in the conceptual model. This method is suitable for analyzing moderation and mediation relationships and generating moderated mediation effects in a predefined model (41). Two PROCESS models were used to analyze these relationships accordingly. First, model 4 was employed to assess the simple mediation effects of IO on the association between health information behaviors (i.e., social media engagement and interpersonal communication) and perceived stress. Second, we applied model 7 to examine the direction relationships and moderated mediation effects. We adopted Preacher et al.’s (42) normal theory-based approach to understand the conditional indirect effect (i.e., moderated mediation, H6). Moderator values at three levels were taken into account, including low (1 standard deviation below the mean), medium (mean), and high (1 standard deviation above the mean). Furthermore, to determine these statistical effects, we

TABLE 3 Moderation and mediation analysis results by using PROCESS macro.

Pathways	b	SE	t	95% CI	P value
Model A: Social media engagement					
SEM → IO	0.79	0.04	17.63	0.70–0.88	<0.001
IO → Stress	0.71	0.04	16.42	0.63–0.80	<0.001
SEM → Stress	0.22	0.05	4.13	0.11–0.32	<0.001
Risk → IO	0.26	0.05	4.38	0.14–0.37	<0.001
Risk → Stress	0.26	0.06	4.39	0.14–0.38	<0.001
SEM*Risk → IO	−0.14	0.03	−4.58	−0.21 – −0.08	<0.001
SME → IO → Stress	0.57	0.06	/	0.46–0.69	/
Conditional indirect effect					
Low COVID-19 risk perception (M-1SD)	0.48	0.06	9.17	0.35–0.60	/
Moderate COVID-19 risk perception (M)	0.41	0.06	7.91	0.28–0.54	/
High COVID-19 risk perception (M+1SD)	0.35	0.07	6.47	0.23–0.49	/
Model B: Interpersonal communication					
IC → IO	−0.09	0.03	−2.91	−0.13– −0.03	0.003
IO → Stress	0.82	0.03	24.72	0.76–0.89	<0.001
IC → Stress	0.06	0.03	2.00	−0.04–0.12	0.053
Risk → IO	0.30	0.04	3.82	0.10–0.47	<0.001
Risk → Stress	0.24	0.06	3.97	0.13–0.38	<0.001
IC*Risk → IO	−0.40	0.04	−1.47	−0.13–0.02	0.130
IC → IO → Stress	0.10	0.03	/	0.04–0.16	/

Unstandardized coefficient values (b) were reported, 5,000 bootstrap sample approach was applied to determine mediation and moderation effects, SEM, social media engagement; IC, interpersonal communication; IO, information overload; SE, standard error; 95% CI, 95% confidence interval; moderating relationships were demonstrated by “variable A*variable B,” gender, age, ethnicity, religion, and education level were included as covariates, Model B could not demonstrate a moderated mediation (conditional indirect) effect as the interaction between IV and moderator was not significant. Bold values refer to statistically significant pathways.

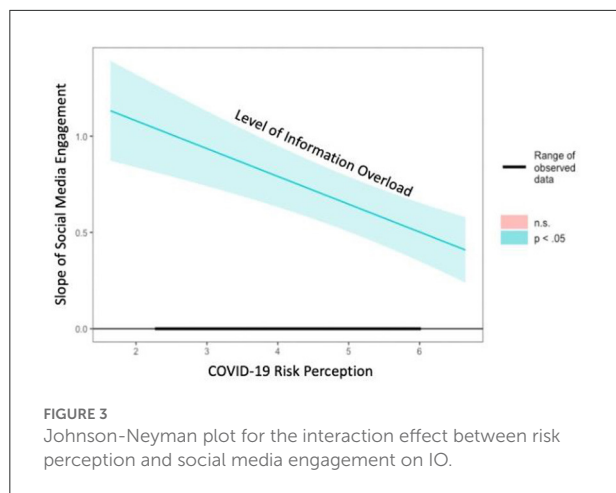
practiced bootstrapping method with 5,000 bootstrap samples at each stage of the analysis; 95% confidence interval (CI) served as a pivotal reference to determine the effect size and level of statistical confidence.

Results

The descriptive statistics for key variables, along with the confirmatory factor analysis (CFA) results, are demonstrated in Table 2. Pertaining to the pathway analysis by using SEM, our conceptual model showed a good fit: $\chi^2/df = 3.162$, CFI = 0.966, TLI = 0.960, RMSEA = 0.057 [95% CI: (0.05, 0.06), $p = 0.028$], SRMR = 0.036. This model explained 52.7% of the variance in the proximal outcome, IO ($R^2 = 0.527$) and 63.2% in the final outcome, perceived stress ($R^2 = 0.632$). Specifically, as shown in Figure 2, social media engagement was positively associated with IO ($\beta = 0.75$, $p < 0.001$), which supports H1. Interpersonal communication revealed a negative association with IO ($\beta = -0.09$, $p = 0.010$), which means H2 was not supported. Furthermore, the result showed that IO was positively associated with perceived stress ($\beta = 0.73$, $p < 0.001$), supporting H3.

Two statistical models were built to analyze moderation and mediation effects accordingly. Model A involves the analyses relating to the pathway from social media to perceived stress. First, regarding whether IO mediates the association between social media engagement and perceived stress. PROCESS macro model 4 was applied. The result (Table 3) showed a significant mediation effect [*Mediation Index* = 0.57, *SE* = 0.06, 95% CI = (0.46, 0.69)], supporting H4a. Particularly, social media engagement was positively associated with IO [$b = 0.79$, $SE = 0.04$, $t = 17.63$, 95% CI = (0.70, 0.88), $p < 0.001$], and increased level of IO was positively related to perceived stress [$b = 0.71$, $SE = 0.04$, $t = 16.42$, 95% CI = (0.63, 0.80), $p < 0.001$]. A partial mediation effect was thus generated.

With regards to the moderation effect of COVID-19 risk perception in the relationship between social media engagement and IO, we used PROCESS macro model 7 to examine it. The result of moderation analysis (Table 3) indicated that there was a significant and negative two-way interaction between social media engagement and COVID-19 risk perception [$b = -0.14$, $SE = 0.03$, $t = -4.58$, 95% CI = (−0.21, −0.08), $p < 0.001$]. This means that risk perception weakened the association between social media engagement and IO, supporting H5a. The Johnson-Neyman plot (43) demonstrated that those with



stronger COVID-19 risk perception are less likely to experience IO when they obtain more information from social media (Figure 3).

Furthermore, the results also demonstrated a significant moderated mediation effect (Table 3). The relationship between social media engagement and perceived stress mediated through IO was further moderated by COVID-19 risk perception [*Moderated Mediation Index* = -0.11 , *Boot SE* = 0.02 , 95% *CI* = $(-0.14, -0.06)$] which supports H6a. Specifically, the indirect effect of social media engagement on perceived stress was stronger among respondents with lower level of COVID-19 risk perception [$b = 0.48$, *Boot SE* = 0.06 , 95% *CI* = $(0.35, 0.60)$], compared to respondents hold moderate level [$b = 0.41$, *Boot SE* = 0.06 , 95% *CI* = $(0.28, 0.54)$] and higher level of COVID-19 risk perception [$b = 0.35$, *Boot SE* = 0.07 , 95% *CI* = $(0.23, 0.49)$]. In other words, this result implies that those who hold a higher level of COVID-19 risk perception would be less likely to perceive stress even with the same degree of social media engagement mediated through IO.

Pertaining to the pathway from interpersonal communication to perceived stress, we formed Model B to analyze relevant mediation and moderation effects (Table 3). First, after analyzing data in PROCESS macro model 4, a significant mediation effect of IO in the association between interpersonal communication and perceived stress was found [*Mediation Index* = 0.10 , *SE* = 0.03 , 95% *CI* = $(0.04, 0.16)$], which supports H4b. Specifically, interpersonal communication was negative associated with IO [$b = -0.09$, *SE* = 0.03 , $t = -2.91$, 95% *CI* = $(-0.13, -0.03)$, $p = 0.003$], and decreased level of IO in turn positively related to perceived stress [$b = 0.82$, *SE* = 0.03 , $t = 24.72$, 95% *CI* = $(0.76, 0.89)$, $p < 0.001$]. Since we did not find a significant direct association between interpersonal communication and perceived stress [$b = 0.06$, *SE* = 0.03 , $t = 2.00$, 95% *CI* = $(-0.04, 0.12)$, $p = 0.053$], a full mediation effect was obtained. However, the results did not

find a moderating effect of COVID-19 risk perception in the relationship between interpersonal communication and IO [$b = -0.40$, *SE* = 0.04 , $t = -1.47$, 95% *CI* = $(-0.13, 0.02)$, $p = 0.130$]. It was also unable to generate a moderated mediation effect. H5b and H6b failed to be supported.

Discussion

This study uncovered the pathways of how health information behaviors cause IO on COVID-19 topics and perceived stress as one of the significant long-term mental health conditions in the COVID-19 context. We also included risk perception, a crucial personal health belief, as the moderator to analyze the interaction effects accordingly. Our model followed the most fundamental and simplified definition of IO, a consequence of engaging information from media channels (12). Since social media platforms have been recognized as the primary avenue where the public usually access health information in the era of infodemic (44), we thus proposed social media engagement as the information engagement approach (i.e., antecedent factor) in the conceptual model. Not surprisingly, the regression results reported that social media engagement was positively associated with IO, and the standardized coefficient was relatively high. It means, when someone engages more COVID-19 information during their daily social media usage, he or she is very likely to feel overwhelmed and fatigued toward COVID-19 relevant topics. This finding was consistent with past studies which discovered the relationship between media usage and IO in different settings. For instance, one study demonstrated that American newsreaders were more likely to feel overwhelmed toward the news content if their preferred news outlet was Facebook (45). Besides, during the earlier stage of the COVID-19 outbreak in South Korea, Hong and Kim (20) found that Koreans were more likely to suffer from IO when they consumed more COVID-19 information from online news sites. Therefore, our results double-confirmed this proposition tradition regarding the relationship between media consumption and IO.

Apart from social media engagement, our model also included interpersonal communication as another health information behavior because it has been identified as a vital information channel during an infectious disease outbreak (2, 46). Surprisingly, our results revealed that interpersonal communication was adversely associated with IO. Meaning, when someone discusses more COVID-19 topics with their family members and friends, the likelihood of feeling overwhelmed toward COVID-19 information reduced. Unlike another finding that reported positive relationship between information engagements on social media and IO, this result's direction diverges from our expectation. In addition, the negative relationship between interpersonal

communication and IO was inconsistent with Hong and Kim (20), which suggests that interpersonal communication was positively associated with IO in the context of the COVID-19 in South Korea. To explain this inconsistency, some reasons are important to note. First, the process of communicating health topics with interpersonal networks involves real-time interaction, which allows individuals to express their ideas, comment on others' statements, and receive feedback concurrently. Unlike social media, which always directs individuals to the most relevant information based on specific algorithms, resulting in a sea of information that may or may not be of interest to individuals, bidirectional or multidimensional face-to-face communication allows an individual to decide what health topics he or she is interested in, which reduces uncertainty and anxiety about the health threat and thus promotes health outcomes (30, 47). Second, in terms of theoretical evidence, interpersonal communication has been conceptualized as one type of metacognitive processing strategy in health knowledge acquisition theories, especially the Cognitive Mediation Model (CMM) (2, 31). Individuals usually talk about the information they learned from media consumption with family and friends, which helps enhance their knowledge structure. As discussing and sharing COVID-19 information with interpersonal networks aids in information digestion, the negative association between interpersonal communication and IO was, therefore, reasonable.

IO was the consequence of two health information behaviors in the conceptual model, which served as the proximal outcome. We next examined whether IO predicts further consequences, such as a long-term mental health condition—perceived stress. The result supported this hypothesis: IO positively predicted perceived stress. When people are overwhelmed with COVID-19 information, they were more likely to suffer from long-term stress. This finding explained how the negative consequences of health information engagement might lead to more mental health issues, extending the scholarship pertaining to the way extant studies understand IO and its relationship with mental health symptoms. For example, one study conducted during the earlier stages of the COVID-19 outbreak in China solely examined the association between IO and anxiety and cognitive dissonance but ignored how IO is triggered (19). Similarly, another study in the UK also analyzed the relationship between COVID-19 IO and fear and fatigue of using social media while neglecting the mechanism of triggering IO (10). To further analyze the role of IO as a proximal outcome from health information behaviors to a mental health state, we performed mediation analysis, and the results confirmed that IO mediated the association between health information behaviors and long-term stress. Hence, our findings proffered conceptual guidance to researchers to better understand this pathway, from the causes of IO to the mental health effects.

Regarding risk perception, which we included it as the moderator in our conceptual model, although only one moderated mediation pathway demonstrated a significant effect, it is still noteworthy. Based on the results, the two-way interaction effect of risk perception and social media engagement had a negative relationship on the amount of IO. In other words, risk perception weakened the positive association between social media engagement and IO. For individuals who believed they had a higher chance of contracting the virus, the pandemic is severe to themselves and their community members; they were less likely to suffer from IO even if they encountered more COVID-19 information through social media usage. This result is in line with the proposition in Zhuang and Guan (34). When someone believes they are vulnerable to a health problem, their information-seeking experiences are more likely to prompt preventative behaviors, such as cancer screening. Meanwhile, our results detected a significant conditional indirect effect in the indirect pathway from social media engagement to perceived stress, mediated by IO, and this pathway was further moderated by COVID-19 risk perception. The negative effects of social media engagement on mental health conditions (i.e., stress) *via* the mediator of IO were stronger when individuals held a lower level of COVID-19 risk perception. This finding further highlights the powerful role of risk perception as a contextual factor in health information processing, which is very likely to influence immediate outcomes and further consequences, such as health conditions and attitudes toward health behaviors. This finding in general is further supported by the joint statement in studies based on the Health Belief Model (HBM) (48). Health beliefs such as perceived threat, efficacy, and potential benefits regarding prevention strategies mobilize healthy behaviors and reduce the likelihood of engaging with risky behaviors (49, 50). Therefore, linking our result with the statement in HBM research, we conclude that existing health beliefs influence health information behaviors and outcomes, especially through simple moderation and moderated mediation pathways.

Implications and limitations

This study offers several implications. At the theoretical level, first, the proposed pathways in the conceptual model reflect the underpinning roles of IO in health information processing, especially during the COVID-19 infodemic. IO is the consequence of health information behaviors on social media and the negative metacognitive processing strategy, which causes an adverse health outcome (i.e., mental health condition). This presents opportunities for future studies to further investigate the functions and mechanisms of IO in health information management.

Second, we uncovered an essential personal health belief, namely, COVID-19 risk perception, as a moderator to

understand the role of a contextual factor in the pathway from information behaviors to health outcome, a mental health condition. Even though only one moderated mediation effect was statistically significant, it still echoes and extends the scholarship in initial theoretical foundations, such as the CMM (31, 32) and the three-stage model of health promotion using interactive media (51).

Third, instead of following the traditional seeking and scanning approach to examine health information behaviors (52), we argued that due to the advancement of information technologies and the infodemic nature, it is hard to say whether individuals intentionally seek or unintentionally scan health information on social media. Thus, we reconsidered and simplified the measurement of health information behaviors on social media, only highlighting individuals' actions with COVID-19 information (i.e., information receiving and expressing) (36). It breaks new ground for future research regarding how online health information behaviors should be measured.

With regards to practical implications, first, our result revealed that during the infodemic era, receiving and expressing COVID-19 information on social media would trigger the chance of suffering from IO, which increases the stress level. As such, during the COVID-19 infodemic, social media companies and media practitioners should devote more efforts to censor and manage relevant content on their platforms, especially those from opinion leaders, online influencers, and other public accounts that have numerous followers. It can create and maintain a less-conflicted information environment for the users, where they then can obtain necessary health knowledge instead of causing IO and other negative health outcomes. Second, we found that COVID-19 risk perception as one type of personal health belief weakens the association between social media engagement and IO. Thus, governments, medical institutions, and health communicators should educate the public to be aware of the severity of the virus by strengthening their health beliefs. It can be done through both online and offline health promotion campaigns. Third, as interpersonal communication was negatively associated with IO in our conceptual model, it can be considered a powerful mechanism to decrease the chance of feeling IO and coping with mental health conditions. Health educators and campaign designers should highlight the crucial roles of face-to-face family communication and peer interaction in the infodemic era. Individuals are encouraged to discuss COVID-19 topics and share their opinions with their social networks to reduce stress.

Despite the implications discussed above, there are some limitations in our study. First, since this study was conducted during a full lockdown period in Malaysia, we could only use a cross-sectional online survey with convenience sampling to recruit respondents. The sample selection contained bias. It failed to reflect the accurate demographic structure in Malaysia, especially the distribution of age, ethnicity, religion, and

education levels. Hence, the generalizability and representability of our results can be further improved. Second, our findings were relatively context-centered. The COVID-19 situation in Malaysia was severe during the time the survey was being conducted. It appears to be a plausible reason why the majority of surveyed respondents perceived higher levels of IO and felt stress (i.e., mean values skewed to strongly agree). If researchers replicate this study in other countries have successfully managed the pandemic, the public's daily life will return to normal; the proposed model may not be supported. Third, only risk perception as the personal health belief was considered a moderator, and a relatively weak interaction was found. This indicates that the moderating effect was not robust enough. However, other health beliefs, such as efficacy perception, might also be important in these pathways, and even moderating power could be more robust than risk perception. Fourth, the measurement of stress we utilized had several methodological concerns. The original operationalization of perceived stress that we adopted included five statements apropos of emotions (38). However, because the original items involved reverse-scored items ($n = 3$) which might cause confusion to respondents due to the possible effect of linguistic skills of respondents, the variance and reliability scores of the construct were affected. Although reverse-scored items are necessary to avoid response bias among respondents, this advice should be interpreted with caution because reports have revealed that reverse-scored items may be confusing to respondents, and that the opposite of a construct reverse-scored may be fundamentally different from the construct (53). Due to the low Cronbach's alpha achieved during the pilot test, we deleted these items and retained only two positive items for analysis. We also noticed that Ngien and Jiang's (38) conceptualization of stress is equivocal as they derived this measurement from the MHI-5 (54), which predominately measure mental health in general, rather than just stress. Therefore, future studies should refine this measurement proposed by Ngien and Jiang's (38) or consider other ways to measure stress for capturing a more holistic understanding. Finally, this study only included perceived stress as a mental health condition. While stress is a most common long-term feeling in the COVID-19 context, other long-term symptoms, such as anxiety and depression, should be taken into account in future research.

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 Committee for Research Involving

Human Subjects (JKEUPM), Universiti Putra Malaysia [UPM/TNCPI/RMC/JKEUPM/1.4.18.2 (JKEUPM)]. The patients/participants provided their written informed consent to participate in this study.

Author contributions

THZ organized the idea, proposed the conceptual model, conducted the literature search, developed the survey instrument, conducted the analyses, and drafted the manuscript. JST guided the statistical analyses. JST, MW, J-NK, J-SJ, PKC, and AMZA reviewed the manuscript. THZ, JST, and MW revised the manuscript. All authors have critically reviewed, provided intellectual input to the manuscript, and approved the final version of the manuscript.

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Conflict of interest

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Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpubh.2022.924331/full#supplementary-material>

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The impact of vaccination upon dental clinic avoidance and the cessation of individual protection measures

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The aim of this study was to analyze the evolution of germ aversion, to perceived infectability and to the fear of COVID-19 from the beginning of the pandemic until the arrival of the vaccines. A repeated measures design was used with three time points during the pandemic. The survey consisted of: Scale of perceived vulnerability to disease; Scale of fear of COVID-19; They were asked if they were vaccinated and if that vaccination is complete. They were asked if they would avoid the dental clinic through fear of COVID-19; and if they have reduced preventive practice in response to COVID-19. A T0-T1 increase in perceived infectability and germ aversion was reported. However, fear of COVID-19 decreased at T1-T2. The vaccinated experienced a greater reduction than the unvaccinated and a greater relaxation of their preventive practice. The frequency of dental avoidance decreased in the vaccinated group from T1 to T2 by 68.3% while in the non-vaccinated this reduction was only 4.9%; $\chi^2 = 18.58$ ($p < 0.01$). In summary, vaccination has had an impact in the reduction of perceived infectability and in reducing fear of COVID-19. Nevertheless, germ aversion has remained stable and independent of vaccination. Empirical support is found for the affirmation that vaccination can reduce certain preventive behavior and dental avoidance.

KEYWORDS

coronavirus infections, COVID-19, infectious disease transmission, professional-to-patient, perceived vulnerability to disease, disease avoidance, dental care

Introduction

The SARS-CoV-2 virus infection (COVID-19) (1) first appeared in China at the end of 2019 and in a few months became a global threat. It was proclaimed a pandemic by the World Health Organization in March 2020 (2). In an effort to reduce the transmission of the virus and the probability of contracting the illness, policies of mitigation control were introduced (3): obligatory mask wearing, disinfection of hands, cleaning of frequently touched surfaces, social distancing, mobility restrictions and time limitations on non-essential activity (4–6). This imposed a drastic change in the daily behavior of citizens who in general followed the guidelines adequately. However, strict

obedience to preventive measures has been influenced by the fear of COVID-19 and an aversion to germs in general (7, 8).

A priori, germ aversion could prove to have positive results by facilitating the identification of possible sources of pathogens and by encouraging avoidance behavior, which could lead to a subsequent reduction in the likelihood of infection (9). Nevertheless, germ aversion may become a real germ phobia and into a highly incapacitating disorder called mysophobia (8).

As well as preventive hygienic measures, the implementation of lockdown in homes and the over-information of the mass media had an impact on physical health and in matters of a psycho-social nature and upon the economy (6, 10). There has been a dramatic decrease in medical consultations, caused by the fear of infection of COVID-19. This lowered rate of attendance may result in aggravated episodes of serious pathology at home, which can have irreversible consequences for patients' health as much at a systemic level as dental (11–13). On the other hand, there are some areas in which telemedicine was essential and the pandemic has accelerated the process, easing the population the access to the sanitary system.

Until now these protective measures have been able to slow the progression of the virus, although the most hopeful strategy for successfully achieving the reduction of levels of mortality and morbilidad continue being vaccination and the development of effective, safe and accessible medicines. By May 2, 2021 a total of 17, 309, 914 vaccination doses (14) have been administered in Spain, of which the percentage in Madrid where the study has been centered has reached 31.2% of the population with one dose and 11.9% with the complete two injections (15). It is apparent that the required herd immunity (estimating the threshold of collective immunity to oscillate between 50 and 67% (16, 17) is still far from being achieved based on current numbers. The acceleration of the vaccination rate against SARS-CoV-2 is encouraging and the population has glimpsed an end to the pandemic. It remains unknown however if the reduction in risk perception will affect the continuation of preventive behavior, which could suppose a change in dental attendance.

As well, this study has as its objective the analysis of the evolution of germ aversion, to perceived infectability and to the fear of COVID-19 from the beginning of the pandemic until the arrival of the vaccines. The impact that vaccines play in modifying the fear of COVID is also evaluated as is any change of attitude with regard to preventive conduct in response to COVID-19 and to dental avoidance.

Materials and methods

Design type

A repeated measures design was used with three time points: before lockdown (T0), after completion of total lockdown (T1)

and when the vaccination process begins in certain risk groups, some essential workers, and the population over 65 years of age (T2).

A self-completed questionnaire was administered to a convenience sample of residents in a district of Madrid (a representative area of the community in socioeconomic terms). In T0, which had not yet declared a state of alarm in Spain or the lockdown (March 1–March 8, 2020) 1,008 on-site respondents participated. The inclusion criteria were to be of legal age and have a good understanding of Spanish. To balance the sample in age and sex, three of the researchers were organized in a district sampling. The nature of the study was explained to them, and they were asked for informed consent to participate and agreed to be followed up later (T1 and T2) by selecting the method (WhatsApp or Email). The questionnaire was collected using a self-administered electronic format. This research was approved by the Ethics Committee of the Universidad Rey Juan Carlos (Registration number: 0103202006520).

At T0, demographic data (age, sex and educational level) and the scale of perceived vulnerability to disease were collected ([Online Appendix](#)).

At T1, from May 4–11, 2020, the total lockdown had been completed in Spain and dental clinics, which had remained open only for dental treatment during the lockdown, were allowed to reopen. All T0 participants were contacted at T1, all T1 participants were contacted at T2. The sample loss at T1 was 4.6% (961), participants no wished to participate. Through Google forms, participants filled out an informed consent for participation and an online form. To avoid contact, the questionnaire was sent to them by email or WhatsApp. All questions appeared consecutively after accepting participation in the study and entering the participant's identification code.

At T1, the survey consisted of: (1) Perceived vulnerability to disease scale (already collected at T0); (2) COVID-19 fear scale (published after T0, so it was not applied at T0); (3) The question was asked if the dental clinic would be avoided through fear of COVID-19 ([Online Appendix](#)).

At T2, Spain had administered at least one dose of the vaccine to workers determined to be essential, risk groups and people over the age of 65 (2–10 May 2021). All T1 participants were contacted to participate in T2. The procedure for the collection of data was the same as T1. There was a 5.6% sample loss due to non-response at T2. Accordingly, the final sample comprised 907 participants.

In this phase, the survey consisted of: (1) Scale of perceived vulnerability to disease (which had already been collected at T0 and T1); (2) Scale of fear of COVID-19 (which had already been collected at T1); (3) They were asked if they were vaccinated and if that vaccination is complete. (4) They were asked if they would avoid the dental clinic through fear of COVID-19; and (5) If they have reduced preventive practice in response to COVID-19. The questionnaire is attached in the [Online Appendix](#).

Instruments

Perceived vulnerability to disease was assessed using an adaptation to the Spanish language of the 15 items Perceived Vulnerability to Disease (PVD) Scale (18). The PVD uses a 7-point Likert-like response format from 1 (totally disagree) to 7 (completely agree). This scale has the two subscales: of perceived infectability (7 items) and germ aversion (8 items). An example of an item in the “Perceived infectability” subscale is “I am more likely to catch an infectious disease than people in my environment”. An example of an item in the “Germ aversion” subscale is, “I prefer to wash my hands right after shaking someone’s hand”. The internal consistency of the PVD scale in the present study was in T0 ($\alpha = 0.75$), T1 ($\alpha = 0.82$) and T2 ($\alpha = 0.87$).

The Spanish version of the fear of COVID-19 scale (FCV-19S) was used to evaluate the participants’ fear of COVID-19 (19, 20). This scale comprises seven items. The FCV-19S uses a 5-point Likert-like response format from 1 (strongly disagree) to 5 (strongly agree), where higher scores indicate greatest fear of COVID-19. For instance, “It makes me uncomfortable to think about coronavirus-19”. The internal consistency of the FCV-19S in the present study in T1 and in T2 was $\alpha = 0.91$ and $\alpha = 0.89$ respectively.

To register the state of the vaccination they were asked: “Are you vaccinated against COVID-19?” The response format was dichotomous (Yes/No). “Have you had the complete vaccination course?” The response format was dichotomous (Yes/No).

Included among the structured questions about dental clinic avoidance were: “Are you currently avoiding going to the dentist because of the fear of COVID-19?” The response format was dichotomous (Yes/No).

With respect to preventive practice in response to COVID-19 the participants were asked: “Have you relaxed the preventive practice of wearing masks in response to COVID-19?” “Have you relaxed the preventive practice of using disinfectant gel in response to COVID-19?” “Have you relaxed the preventive practice of maintaining social distance in response to COVID-19?” “Have you relaxed the preventive practice of wearing masks with social contacts in response to COVID-19?”

Participants rated the questions using a five-point Likert scale, using the responses 1(not at all) to 5 (extremely). The point scoring of all the questions was added to evaluate the degree of relaxation of the preventive practices with a range from 4 to 20. Higher points indicate a greater cessation of preventive practices.

Statistical analysis

Statistical analysis used SPSS version 24 (SPSS Inc., Chicago, IL, USA). Data analysis included descriptive statistics and

TABLE 1 Sociodemographic characteristics in T0 (N = 1008).

	Total 1008 (100%)
Age	
M (SD)	38.9 (16.6)
Gender	
Men N (%)	418 (41.50%)
Women N (%)	590 (58.50%)
Education level N (%)	
Primary	125 (12.3%)
Secondary	278 (27.7 %)
Higher education	605 (60 %)

the Kolmogorov–Smirnov test to evaluate the as-sumption of normality, which was confirmed. Paired *T*-tests examined differences in T0–T1–T2 for continuous variables. Pearson’s correlation coefficient was used to analyse the association between continuous variables. The difference in the relaxation of preventive measures was evaluated by Student’s *t*-test. The chi-square test was used to evaluate the change in dental avoidance between vaccinated and unvaccinated. A 2×2 ANOVA was carry out to explore dental visit avoidance and vaccination on fear of COVID-19. Statistical significance was established at $p < 0.05$.

Results

Table 1 shows that the sample in T0 was composed of 1,008 participants (40% men, 60% women). The mean age of the participants was 38.4 years (± 16.1).

13.3% of the participants ($N = 126$) are vaccinated, however only 4% ($N = 36$) have completed the full course. The group of the vaccinated presents an average age of 62.07 ± 18.35 while the non-vaccinated group presents an average age of 35.38 ± 12.46 .

Perceived infectability, aversion to germs, and fear of COVID-19

Participants reported a significant increase from baseline to T1 in the perceived infectability sub-scale (Cohen’s *d*: 0.72) and in the germ aversion sub-scale (Cohen’s *d*: 0.9). However, there was a significant decrease T1–T2 in the perceived infectability sub-scale (Cohen’s *d*: 0.78), the germ aversion sub-scale was maintained at T1–T2. There was a significant decrease in fear of COVID-19 in T1–T2 (Cohen’s *d*: 0.78). See Table 2.

As shown in Table 3, there is a significant positive correlation between the COVID-19 fear scale in T1 and the

TABLE 2 Mean, standard deviation, *N* (%) in T0–T1, T1–T2, and significance in T0–T1, T1–T2 for the variables of perceived vulnerability to infection (Infectability subscale and Germ-Aversion Subscale) and fear of COVID-19.

Variables	T0	T1	T2	T0-T1 <i>p</i> -value	T1-T2
Vulnerability to infection					
Infectability subscale	3.3 (1.1)	4.1 (1.1)	3.2 (1.2)	<0.001**	<0.001**
Germ-Aversion Subscale	3.5 (1.1)	4.5 (1.1)	4.6 (1.2)	<0.001**	0.105
Fear of COVID-19		20.8 (6.8)	15.9 (7.2)		<0.001**

**Significance at the 0.01 level.

TABLE 3 Cronbach's Alpha and intercorrelations between subscale of infectability and germ aversion (T0, T1, T2) and fear of COVID-19 (T1, T2).

Theoretical range	α	1	2	3	4	5	6	7	8
1. Infectability subscale T0 (1–7)	0.783		0.284**	0.219**	0.579**	0.229**	0.175**	0.248**	0.047
2. Infectability subscale T1 (1–7)	0.859			0.530**	0.190**	0.823**	0.521**	0.323**	0.137*
3. Infectability subscale T2 (1–7)	0.765				0.153**	0.436**	0.352**	0.185**	0.253**
4. Germ aversion subscale T0 (1–7)	0.729					0.208**	0.120**	0.326**	0.120**
5. Germ aversion subscale T1 (1–7)	0.771						0.594**	0.183**	0.113**
6. Germ aversion subscale T2 (1–7)	0.763							0.158**	0.099**
7. Fear of COVID-19 T1 (7–35)	0.913								0.329**
8. Fear of COVID-19 T2 (7–35)	0.882								

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

sub-scales of perceived infectability and germ aversion in T0, T1 and T2 ($p < 0.01$). Furthermore, a strong positive association was found between the germ aversion sub-scale in T2 and perceived infectability in T1 ($r^2 = 0.521$, $p < 0.01$) and Germ aversion in T1 ($r^2 = 0.594$, $p < 0.01$). Significant differences were found in T1-T2 for the fear of COVID-19. The vaccinated experienced a greater reduction [T1= 26.83 (6.81); T2 = 17.15 (8.35)] than the non-vaccinated [T1= 19.89 (6.29); T2= 15.4 (7.17)]. See [Table 4](#) and [Figures 1–3](#).

Measures of protection against COVID-19

The vaccinated have relaxed their preventive practice (7.78 ± 4.39) in comparison with the non-vaccinated (7.31 ± 1.23) ($t = 2.461$, $p = 0.014$). Nevertheless, no differences exist between those having

the complete vaccination (8.75 ± 5.18) or incomplete (8.75 ± 5.18).

Avoidance of dental visit

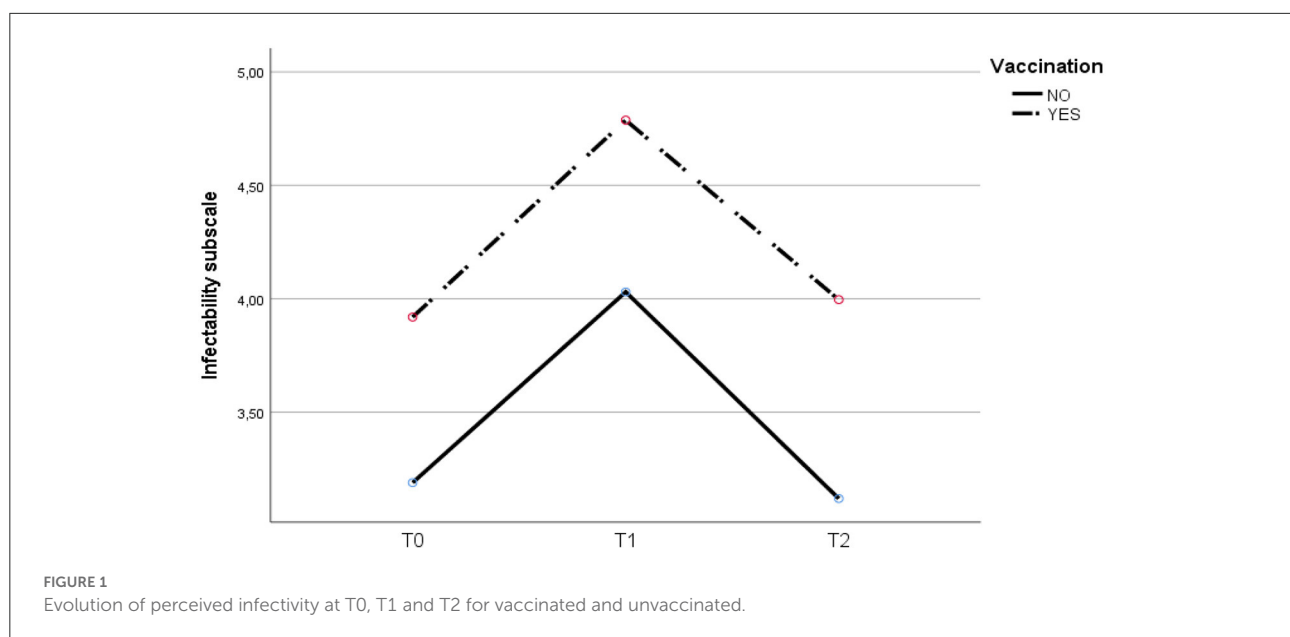
As can be seen in [Table 5](#), the non-vaccinated group is a younger group in which dental avoidance in T1 was less than in the vaccinated group [$X^2 = 15.33$ ($p < 0.01$)]. Nevertheless, the frequency of dental avoidance has diminished in the vaccinated group from T1 to T2 by 68.3% ($N = 86$) while in the non-vaccinated this reduction has only been 4.9% ($N = 38$); $X^2 = 18.58$ ($p < 0.01$).

An ANOVA 2×2 was conducted to explore the avoidance of dental visits and vaccination in response to the fear of COVID-19. The value of relevance for the case of dental visit avoidance is not significant [$F_{(1,3)} = 0.072$; $p = 0.39$], neither is that for vaccination [$F_{(1,3)} = 2.35$; $p = 0.125$], however the interaction

TABLE 4 Mean, standard deviation and significance according to vaccination for the variables of Vulnerability to infection and Fear of COVID-19 in T0, T1, T2.

Variables	Vaccinated	No Vaccinated	Vaccinated	No Vaccinated	Vaccinated	No Vaccinated	Vaccinated/ No Vaccinated	Vaccinated/ No Vaccinated
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	<i>p</i>	<i>p</i>
	T0	T0	T1	T1	T2	T2	T0-T1	T1-T2
Vulnerability to infection								
Infectability subscale	3.9 (1.4)	3.1 (1)	4.7 (1.2)	4 (1.1)	3.9 (1.4)	3.1 (1.1)	0.669	0.298
Germ-Aversion Subscale	4.1 (1.4)	3.5 (1)	5.1 (1.2)	4.5 (1.1)	5.1 (1.2)	5.1 (1.2)	0.945	0.557
Fear of COVID 19			26.8 (6.8)	19.8 (6.2)	17.1 (8.3)	15.4 (7.1)		<0.001**

**Significance at the 0.01 level.



of vaccination and dental avoidance on the Δ fear of COVID-19 T1-T2 was significant [$F_{(1,3)} = 4.92$; $p = 0.027$; $\eta^2 = 0.005$].

Discussion

With this study the evolution of the pandemic has been analyzed from its beginning to the arrival of vaccination as it relates to the fear perception of COVID-19, to the perceived infectability and to germ aversion. The data of this research indicates that a habituation has been produced in the population in response to COVID-19, because, faced with a repeated stimulus the answer is increasingly less intense. This occurs as much with the fear of COVID-19 as it does with perceived infectability (21, 22).

The habituation can be considered the most primitive process of learning and occurs at all levels of the organism, from the cellular to the psychological (23). The aversion to germs has

practically remained constant from T1 to T2, however it suffered an important increase from T0 to T1. This can be explained by the lack of knowledge about the modes of transmission of COVID-19 at the beginning of the pandemic, provoking a traumatic situation through the need to maximize hygiene as a protective measure in response to the virus. Also, the excess of information may have been influenced by the mass media. This data agrees with the results found in the bibliography about the increase in germ aversion during lockdown (24). Similar results were also found by Eder et al. (25), showing that aversion to germs is associated with the fear of COVID-19. Due to the lack of efficient treatment, the principal way of reducing the propagation of COVID-19 is preventing the transmission of the virus between people by means of raising awareness, vaccination and the adoption of adequate preventive practices (5, 26, 27). In addition, healthy behaviors that help to improve the prognosis in case of SARS-CoV-2 infection should be promoted, such as: balanced diet, physical activity, avoiding

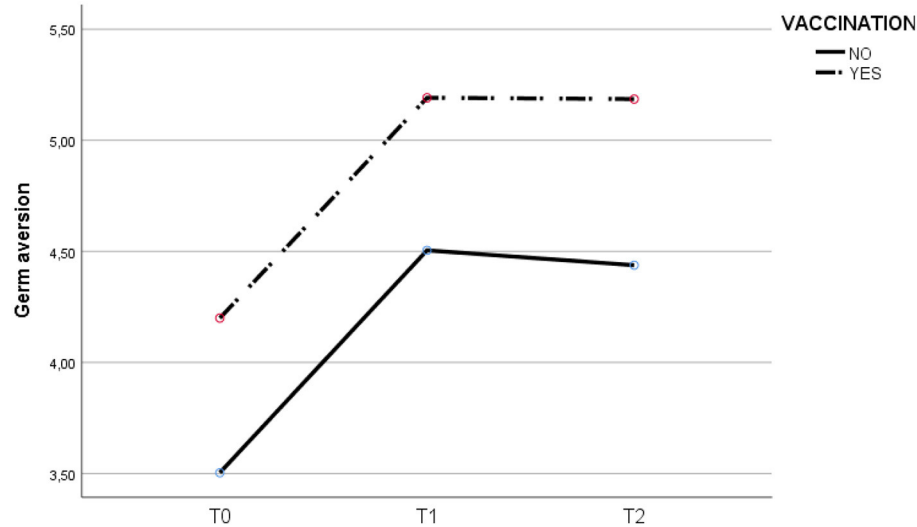


FIGURE 2
Evolution of germ aversion at T0, T1 and T2 for vaccinated and unvaccinated.

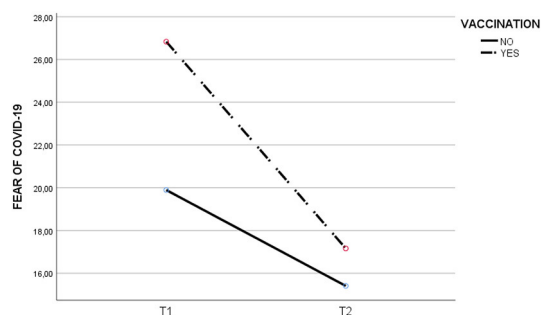


FIGURE 3
Evolution of COVID-19 fear at T0, T1 and T2 for vaccinated and unvaccinated.

tobacco and alcohol consumption habits (28–31). In Madrid the accumulated incidence remains elevated, 277.19, and the details of this study confirm that preventive practices are being relaxed. This could be explained by two possible causes: the general form of COVID-19 fear has declined, and vaccination has reduced the perception of risk. As well, people balance this less perceived risk by reducing other preventive behavior.

The hypothesis of balancing risk in the context of vaccination conduct was studied in Lyme's disease although no complete inhibition free behavior was found (32). However, the reduction of perceived risk may not be the prime driver of risk behavior. There is also the perception of benefits, a belief that restrictive behavior is associated with contagion and illness and a belief in the efficiency of the vaccine and closer social contact play very important roles.

The limitations of this study are linked to the sample used. It is a sample of convenience and not representative and therefore its results cannot be extrapolated. A possible second limitation comes from the using of measures of auto-information whose answers are based more on social desirability than reality. The third limitation is associated with methodology and the implementation of non-standardized measures to register the preventive behavior of the participants and not permit, through design limitations, the establishment of causal relationships in all of the results. Because of this future line of research will be required to confirm the results. However, the similarities of the results of this study lead us to think that the findings provided can contribute to the current pandemic debate. It should not be forgotten that the population is found on a world stage upon which viral variants are increasing. Several of these are being studied for their greater potential for contagion and severity and for the probability that they can elude the protection that currently approved vaccines have conferred.

For this reason, this study endorses the need for undertaking adequate interventions directed toward the promotion of health, to raising awareness of the measures of preventive practice, healthy behaviors and to the acceleration of vaccination.

Conclusion

In summary, vaccination has had an impact in the reduction of perceived infectability and in reducing fear of COVID-19. Nevertheless, germ aversion has remained stable and independent of vaccination. Empirical support is also found for

TABLE 5 Comparison of the frequency of dental avoidance at T1-T2 in vaccinated ($N = 126$) and unvaccinated ($N = 781$) at T2.

	T2			
	VACCINATED		UNVACCINATED	
T1	I would not go to the dentist N (%)	I would go to the dentist N (%)	I would not go to the dentist N (%)	I would go to the dentist N (%)
I would not go to the dentist $N = 227$ (25%)	7 (5.6%)	86 (68.3%)	96 (12.3%)	38 (4.9%)
I would go to the dentist $N = 680$ (75%)	0 (0%)	33 (26.2%)	28 (3.6%)	619 (79.3%)
Total $N = 907$ (100%)	7 (5.6%)	119 (94.5%)	124 (15.9%)	657 (84.1%)

the affirmation that vaccination can reduce certain preventive behavior and dental avoidance.

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 study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics and Research Committee of REY JUAN CARLOS UNIVERSITY (Registration number: 0103202006520 and 03/03/2020). The patients/participants provided their written informed consent to participate in this study.

Author contributions

MC-D and MG-O: Conceptualization, formal analysis, data curation, and writing—original draft preparation. MC-D, MG-O, MR-M, and BD-R: investigation. MR-M and BD-R: resources. MR-M: supervision. RG and MR-M: writing—review and editing. RG: methodology. All authors have read and agreed to the published version of the 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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Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpubh.2022.864783/full#supplementary-material>

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Anxiety and coping strategies during the COVID-19 pandemic: A cross-sectional study of staff and students from a tertiary education center in Malaysia

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Aim: We examined the anxiety levels and coping strategies among staff and students of a tertiary educational institution during the COVID-19 pandemic and determined the association between anxiety level and coping strategies.

Method: Through an online survey, we used Coronavirus Anxiety Scale (CAS) to measure the level of anxiety associated with the COVID-19 crisis and Brief Coping Orientation to Problems Experienced (COPE) to assess the coping responses adopted to handle stressful life events. Coping strategies were classified as adaptive and maladaptive, for which the aggregate scores were calculated. Multiple linear regression was used to determine the predictors of anxiety adjusted for potentially confounding variables. Results from 434 participants were available for analysis.

Results: The mean score (SD) of the CAS was 1.1 (1.8). The mean scores of adaptive and maladaptive coping strategies were 35.69 and 19.28, respectively. Multiple linear regression revealed that maladaptive coping [Adjusted B coefficient = 4.106, p -value < 0.001] and presence of comorbidities [Adjusted B coefficient = 1.376, p -value = 0.025] significantly predicted anxiety.

Conclusion: Maladaptive coping and presence of comorbidities were the predictors of coronavirus anxiety. The apparent lack of anxiety in relation to COVID-19 and movement restriction is reflective of the reported high level of satisfaction with the support and services provided during the COVID-19 outbreak in Malaysia. Adaptive coping strategies were adopted more frequently than maladaptive. Nevertheless, public education on positive coping strategies and anxiety management may be still be relevant to provide mental health support to address the needs of the general population.

KEYWORDS

anxiety, coping, COVID-19, university, Malaysia

Introduction

The COVID-19 pandemic is a serious global health problem that poses threats to both the physical and mental wellbeing. A meta-analysis found that the pooled prevalence of anxiety was 31.9% among the general population during the COVID-19 pandemic (1). Another review indicated that anxiety level has increased 3-fold during the COVID-19 outbreak among the general population (2). The anxiety generated could be due to a multitude of reasons including the health risk posed by the virus on themselves and their families, the economic burden on themselves and the fallout at large (3), as well as the enforced social isolation during the pandemic (4). Anxiety is a natural response to stress. The symptoms of anxiety include nervousness, restlessness, fatigue and weakness, palpitations, trouble concentrating and insomnia (5–7). Significantly, studies have suggested that prolonged anxiety can reduce quality of life and weaken the immune system (8, 9) and as a result increases the risk of the SARS-Cov2 infection (10). Further, the restrictive measures imposed to curb the spread of the virus, and the associated changes in lifestyle and work arrangements, as well as the severe limitations in social and physical activities have exacted a heavy toll on people. Over an extended period of time, this could result in mental fatigue and stress. It is not surprising, therefore, that frequency of anxiety has been reported to be an increasing health problem arising out of the pandemic.

The pandemic situation that the world is facing now is not new, albeit, it is much more serious in many aspects compared to outbreaks in the recent past. Likewise, many people affected by previous pandemics have experienced and endured similar situational threats and stress at the individual level. During previous outbreaks, many studies have been carried out to address the issue of mental health and anxiety arising therefrom, and how people handle such problems (11–13). In these studies, it was demonstrated that there is an association between anxiety levels, mental resilience and coping styles (14–16).

With regards to teaching and learning, the seriousness of the current pandemic has led most educational systems to adopt online teaching modes, especially in higher education institutions, with all its challenges to teaching and support staff and to students. Transitioning from traditional face-to-face to online teaching-learning can be an entirely different experience and/or challenge for both the learners and the educators. Regardless, this is a change that they must adapt to within a short time frame in the face of limited alternatives. They are compelled to adopt online platforms that they may or may not be prepared for, depending on the expertise and previous exposure to information and communications technology (ICT) (17). It was pointed out by Doucet A, et al. (18) that the readiness of the staff and students to adapt to these changes needs to be assessed to allow for appropriate implementation of supportive measures. In the same paper, it was also emphasized that there is no one uniform pedagogy that can be applied

across all online subjects which, understandably, will be quite varied each with its own unique requirements both in terms of presentation and delivery of the subject matter. All these issues could present a significant challenge and stress for the entire university community (17). Lastly, there is the issue of equity in higher education, an example in case is students from economically challenged background who may face problems of affording online learning devices and/or reliable internet services (19). Essentially, both staff and students alike have to adapt to the changes in operational, teaching and learning modes, and at the same time cope with the uncertainties related to the evolution of the SARS-Cov2 virus, the course of the pandemic and thus movement restriction as well as their own infection risk.

As a result, questions on the psychological welfare of members of the teaching community has aroused the interest of the research community, hence, the numerous studies to address this issue. Islam et al. (20) reported that 18.1% (19) and Nayan et al. (21) reported 22% of university students from Bangladesh suffered from serious anxiety. Factors reported to be associated with COVID-19 related anxiety among Bangladeshi university students include lagging academic performance (19) and negative attitudes. A study on Middle-Eastern students from Jordan gave a similar prevalence of 21.5% (22); reported predictors of anxiety were chronic illness and, surprisingly, those with higher income. Yang et al. (23) reported that the prevalence of mild, moderate and severe anxiety among University students in Sichuan Province, China were 31.5, 8.1 and 5.8%, respectively, with medical students and those who paid more attention to pandemic information being more likely to be affected. Another study reported the prevalence of mild, moderate and severe anxiety among medical students in India were 41, 16 and 4%, respectively (24). A local study addressing the impact of COVID-19 related anxiety on mental health among Malaysian university students found that 30.5% experienced mild anxiety, 31.1% moderate anxiety and 26.1% severe anxiety; factors associated with anxiety included age over 20 years, Chinese ethnicity, decrease in family income, spending a lot of time watching COVID-19 related news and lastly, history of personal illness and of SARS-CoV-2 infection among friends and relatives (25).

The next question that would be expected is how people facing the stress and anxiety posed by the pandemic cope, and in what way the coping strategies adopted relates to mental health. A study from the United Kingdom (United Kingdom) found that both adaptive and maladaptive coping strategies were used, including socializing with loved ones, exercising, keeping occupied with work or studies, meditating and keeping positive, avoiding negative news on COVID-19, gaming, and taking alcohol (26). An online survey to examine coping strategies used among netizens, nationalities unspecified, found that a large proportion (68.9%) reported that they just hoped for the best, over half (53.2%), just kept themselves busy while around

30 to 35% used religion, or share their concerns with others (15). Mental disengagement was found to be the most common coping method used by university students in China to handle their anxiety; this was followed by avoidance and seeking social support (27).

With regards to the relationship between coping methods and anxiety, a study among nursing students showed that mental disengagement was predictive of moderate to severe anxiety and lack of humor predictive of severe anxiety (14). Another study done among Polish University students (28), reported that anxiety was significantly and inversely correlated with task-oriented coping style, while anxiety was significantly and positively correlated with emotion-oriented coping style and avoidance-oriented coping style.

From the above, it is apparent that literature on the relationship between coping methods and anxiety in the context of the COVID-19 pandemic is generally lacking, both in numbers and coverage. Hence the attempt of the present study to provide some additional data on coping strategies used and their relationship with anxiety among the UTAR community of staff and students. We propose to determine baseline information on the frequency and level of anxiety in this study population, the predictors of COVID-19 anxiety, the frequency of different coping strategies adopted, and the association, if any, between coping strategy and anxiety. Indeed, to date, there has been only one study on anxiety and associated risk factors in Malaysian students (25), and none that address the question of coping strategies and their association with anxiety. Further, we observed that the WHO questionnaire (29) mentions multiple aspects which are deemed relevant and may have an association with anxiety levels, including compliance with preventive measures, satisfaction with support and resources, frequency of updating COVID-19 news, self-risk perception, preparedness, and perceived self-efficacy, and unwanted behavior. Therefore, in the present study, we also explored these factors which are less often addressed in the literature, in comparison to questions on the associations with knowledge, attitude, and socio-demography.

Materials and methods

Participants

A cross-sectional online survey was conducted among staff and students of Universiti Tunku Abdul Rahman (UTAR) City campus which consists of 11,541 members (administrative staff, $n = 414$, academic staff, $n = 717$; students, $n = 10,410$). All administrative and academic staff and students of UTAR in Sungai Long Campus were invited to participate in the survey which was conducted between September 1, 2020 and February 28, 2021. This study was part of a broader study which included other aspects related to the COVID-19 pandemic

such as knowledge, behavior, self-risk perception (probability, susceptibility and severity) and self-efficacy (protective and avoidance ability) (30).

Sample size was calculated using G*Power 3.1 (Linear multiple regression: fixed model, R^2 deviation from zero) (31). Assuming partial R^2 of 0.05 (32), effect size (F square) of 0.0526, power of 0.95 and level of significance 0.05, with 18 predictors a minimum sample size of 250 was needed.

Ethical clearance and procedure

This study was approved by the UTAR Scientific and Ethical Review Committee (approval number: U/SERC/138/2020). Prior to responding to the survey, each participant was informed about the purpose of study, requested to provide signed informed consent and advised about the right to refuse participation and to withdraw at any time.

Instruments and scoring method

The Coronavirus Anxiety Scale (CAS) was used to measure the level of anxiety associated with the COVID-19 crisis (33) and the Brief COPE to determine the respondent's primary coping styles (34). The CAS is a 5-items mental health screener with 5-point Likert scale ranging from "Not at all" (score 0), "Rarely to twice or less" (score 1), "Several days" (score 2), "More than 7 days" (score 3), and "Nearly every day" (score 4) over the last 2 weeks. The total score ranges from 0 to 20. A cut-off score of ≥ 9 indicates dysfunctional anxiety (33).

The Brief COPE, an abbreviated version of COPE (Coping Orientation to Problems Experienced) is a 28-item self-report questionnaire designed to assess the coping responses adopted to handle stressful life events (34). It contains 14 subscales with 2 items in each subscale, rated by a four-point Likert scale ranging from "I haven't been doing this at all" (score 1), "I've been doing this a little bit" (score 2), "I've been doing this a medium amount" (score 3), and "I have been doing this a lot" (score 4). The higher the score of each subscale, the greater the likelihood for use of that particular coping strategy by the respondent. The 14 subscales in Brief COPE can be classified as "adaptive" and "maladaptive" coping methods. Adaptive coping strategies comprises the first eight scales which consist of active coping, planning, positive reframing, acceptance, humor, religion, using emotional support and using instrumental support. Maladaptive coping comprises the latter six subscales which include self-distraction, denial, venting, substance use, behavioral disengagement and self-blame (34). The scores for the adaptive and maladaptive coping were calculated individually and totalled for each participant; the respective scores were used separately in multiple regression analysis.

The World Health Organization questionnaire “Monitoring knowledge, risk perceptions, preventive behaviors and trust to inform pandemic outbreak response” (29) was used to determine the (i) prevention - own behavior, (ii) frequency of updating news on COVID-19, (iii) satisfaction with support and resources, (iv) self-risk perception (probability and severity), (v) preparedness and perceived self-efficacy, and (vi) unwanted behavior. Prevention (own behavior) was assessed by 10 questions [Scores based on a 7-point Likert scale, options being “Not at all” (1 mark) to “Very much so” (7 marks). The frequency of updating news on COVID-19 was scored based on a 7-point Likert scale [Options include “Never” (1 mark) to “Several times a day” (7 mark)], and satisfaction with support and resources provided with options being “satisfied” and “not satisfied”. Risk perception was explored using three questions covering probability of contracting the infection, susceptibility to the infection and the severity of the illness if infected. Preparedness and perceived self-efficacy comprised two questions on self-protection ability and disease-avoidance ability. Scoring was based on a 7-point Likert scale. In both cases the scores for the individual items were summed to give an aggregate score for statistical analysis. Lastly, unwanted behavior was interrogated using 6 items [Options include “Does not apply” (score 0), “I don’t plan to do that” (score 1), “I plan to do that” (score 2), and “I already did that” (score 3)].

Statistical analysis

Data analysis was performed by using the IBM SPSS Statistics Version 21.0 for Windows. Participants who failed to respond to any one item included in any scale were excluded from statistical analysis. For descriptive statistics, data are presented either as mean $\pm$ standard deviation to describe continuous variables or frequency (percentage) to describe categorical and numerical variables. Simple linear regression was conducted to identify factors associated with the coronavirus anxiety. Variables with p -values <0.25 were selected for further analysis using multiple linear regression to obtain adjusted B coefficients and their standard errors using the enter method. Variables with a p -value <0.05 were considered statistically significant.

Further analysis was performed to determine if compliance with preventive measures, frequency of updating about the COVID-19 pandemic, perceived self-risk, preparedness and perceived self-efficacy, and behavior have mediating effects on the relationship between maladaptive coping and the coronavirus anxiety. This was based on 5000 bootstrap resamples and employed the PROCESS macro in IBM SPSS version 21 (35).

Results

Characteristics of respondents

Out of 11,541 UTAR staff and students being approached, 435 accessed the online survey and 434 consented and completed the online survey. The demography of participants which comprise 93 staff members and 341 students is presented in Table 1. The mean age of staff members was 36.6 years (range 19–74 years) and that of students was 21.6 years (range 18–35 years), with females making up 67.7% among staff and 58.4% among students. With regards to the educational level, more than half (55.9%) of staff members had a postgraduate or professional degree and 88.5% of students were pursuing an undergraduate degree. Overall, 88.7% were single and 92.9% reported absence of any comorbidity. In terms of living arrangements, 73.7% resided within red (high risk) zones; just over 95% lived in household of 2 or more people; 35% of the participants lived in households with children and 32.3% in households with elderly people.

Compliance with preventive measures, satisfaction with support, frequency of updating information on COVID-19, risk perception, self-efficacy and behavior

The majority (74%) were compliant with the public health measures recommended, more so among the staff members. Likewise, the large majority (82.5%), were satisfied with the support services provided, staff and students equally so. Just under 30% reported that they update themselves regarding the COVID-19 status very frequently (score 6–7), of whom about 10% do so several times a day (Table 2).

Coping methods

Brief-COPE exhibited good internal consistency in this study (Appendix 1); the Cronbach’s alpha coefficient for subscales ranged from 0.576 (Planning) to 0.936 (Substance use) which is comparable to that reported (18). The frequency of response for the 28 items of the Brief-COPE are summarized in Appendix 2.

For analysis, the Brief COPE items were categorized into adaptive and maladaptive coping methods, following the recommendations of Meyer (2001) (36). Based on this model (Table 3), the proportion of respondents who use the various adaptive coping strategies ranged from a low of 12.9% (humor) to a high of 70.5% (acceptance); the average aggregate score was 35.7 ± 9.4 . It is observed that about a fifth (20.3%) of the respondents used religion. The proportion of respondents who

TABLE 1 Characteristics of participants.

Characteristics	Category	All (<i>n</i> = 434)
Age	Mean $\pm$ Standard deviation	24.8 $\pm$ 8.5
	Median (Interquartile range)	22 (2.3)
	Minimum age—Maximum age	18–74
Gender <i>n</i> (%)	Male	172 (39.6)
	Female	262 (60.4)
Role in tertiary education <i>n</i> (%)	Administrative staff	43 (9.9)
	Academic staff	50 (11.5)
	Student	341 (78.6)
Highest education level obtained among staff <i>n</i> (%)	Secondary	20 (21.5)
	Diploma/Bachelor degree	21 (22.6)
	Postgraduate/professional degree	52 (55.9)
Level of education pursued among students <i>n</i> (%)	Foundation	31 (9.1)
	Undergraduate degree	302 (88.6)
	Postgraduate degree	8 (2.3)
Marital status	Single	385 (88.7)
	Married	47 (10.8)
	Divorced	2 (0.5)
Highest education level completed by respondents	Secondary school	353 (81.3)
	Diploma or Bachelor degree	27 (6.2)
	Postgraduate or professional degree	54 (12.4)
Presence of comorbidities	Without	403 (92.9)
	With	9 (2.1)
	Unsure	22 (5.1)
Zone of residence	Green	29 (6.7)
	Yellow	44 (10.1)
	Red	320 (73.7)
	Unsure	41 (9.4)
Household size	Staying alone	14 (3.2)
	2–4 people	229 (52.8)
	≥ 5 people	191 (44.0)
Living with children	Yes	152 (35.0)
	No	282 (65.0)
Living with elderly	Yes	140 (32.3)
	No	294 (67.7)

Data are presented in frequency (%).

frequently adopt maladaptive coping, with the exception of self-distraction (33.9%), was quite low, ranging from 4.8% (substance use) to 10.4% (venting).

Further analysis was performed to see if there was any difference in the preference of coping methods between staff and students (Appendix 3). It was found that almost half the staff (49.5%) use positive reframing frequently as a means of coping compared to students (35.8%), a difference that was statistically significant ($p = 0.016$). A statistically significant difference ($p < 0.001$) was found only for the use of religion, with staff (36.3%) being more reliant on this mode of coping compared to students (15.8%). There was no

significant difference between these two groups with respect to the remaining subscales.

As shown in Table 4, the aggregate scores (average) for adaptive and maladaptive coping were 35.7 (55.8%) and 19.3 (40.2%), respectively.

Anxiety related to the COVID-19 pandemic

The Coronavirus anxiety scale was assessed using the Cronbach's alpha reliability method; Cronbach's alpha value was

TABLE 2 Compliance with COVID-19 preventive measures, satisfaction with support and resources, frequency of updating about the COVID-19 pandemic, risk perception, self-efficacy, unwanted behavior ($n = 434$).

Characteristics	Category	All respondents ($n = 434$)
Compliance with COVID-19 preventive measures (total score = 7) [Options—"Not at all" (1 mark) to "Very much so" (7 marks)]	Low compliance (score 1–2)	Frequency in number and % ()
	Moderate compliance (Score 3–5)	1 (0.2)
	High compliance (Score 6–7)	112 (25.8)
	Mean $\pm$ Standard deviation	321 (74.0)
	Median (Interquartile range)	5.9 $\pm$ 1.0
	Range	6 (2)
Satisfaction with support and resources	Not satisfied	02-Jul
	Satisfied	76 (17.5)
Frequency of updating about the status of the COVID-19 pandemic (total score = 7) [Options—"Never" (1 mark) to "Several times a day" (7 mark)]	Infrequent (score 1–2)	358 (82.5)
	Frequent (Score 3–5)	38 (8.8)
	Very frequent (Score 6–7)	274 (63.1)
	Mean $\pm$ Standard deviation	122 (28.1)
	Median (Interquartile range)	4.7 $\pm$ 1.4
	Range	5 (2)
Self-risk perception (total score = 21) [Options—"Not at all" (1 mark) to "Very much so" (7 marks)]	Mean $\pm$ Standard deviation	01-Jul 11.47 $\pm$ 2.66
	Median (Interquartile range)	12.0 (3.0)
	Range	May-21
	Mean $\pm$ Standard deviation	10.25 $\pm$ 1.73
Preparedness and perceived self-efficacy (total score = 14) [Options—"Not at all" (1 mark) to "Very much so" (7 marks)]	Median (Interquartile range)	10.0 (2.0)
	Range	May-14
	Mean $\pm$ Standard deviation	7.21 $\pm$ 3.33
	Median (Interquartile range)	7.0 (4.0)
Unwanted behavior (total score = 18) [Options—"Does not apply" (score 0), "I don't plan to do that" (score 1), "I plan to do that" (score 2) and "I already did that" (score 3)].	Range	0–18

0.683 indicative of satisfactory level of reliability ([Appendix 4](#)). The frequency of response for each item in the Coronavirus anxiety scale is summarized in [Appendix 5](#).

[Table 5](#) is a summary of the descriptive analysis of anxiety level related to COVID-19 according to the CAS scale. As recommended, scores ranging from 0–8 are considered to indicate low level anxiety while scores of 9 or higher to indicate high level anxiety or dysfunctional anxiety. The results show that 430 respondents (99.1%) had scores ranging from 0–8, of whom 261 (60.1%) scored zero which is indicative of the absence of any symptoms of anxiety (henceforth referred to as normal). The remaining 169 (38.9%) will be considered to have mild-moderate level of anxiety. Only a very small number of the respondents ($n = 4$; 0.9%) had scores that indicate the presence of dysfunctional anxiety. There is no significant difference in the anxiety scores between staff and students.

Predictors of anxiety

Based on multiple linear regression analysis ([Table 6](#)), the factors associated with coronavirus anxiety score were maladaptive coping [Adjusted B coefficient (standard error) =

4.106 (0.902), p -value <0.001] and presence of comorbidities [Adjusted B coefficient (Standard error) = 1.376 (0.610), p -value = 0.025]. The mediating effects of compliance with preventive measures, frequency of updating about the COVID-19 pandemic, self-risk perception, preparedness and perceived self-efficacy, and unwanted behavior, on the association between maladaptive coping and coronavirus anxiety were not significant ([Appendix 6](#)).

Discussion

This study aimed to determine (i) the coronavirus anxiety levels among UTAR's staff and students during the COVID-19 pandemic, (ii) the coping strategies adopted, and (iii) the predictors of coronavirus-related anxiety, adjusting for potential confounding variables.

Coronavirus anxiety

Various studies have been carried out, mainly during the initial onslaught of the COVID-19 pandemic, to study its

TABLE 3 Number (%) of respondents who frequently used the coping methods listed ($n = 434$).

Coping methods (subscale)	Non-favored coping method (Total score: 2–5) Number (%)	Favored coping method (Total score: 6–8) Number (%)
Active coping	235 (54.1)	199 (45.9)
Planning	320 (73.7)	114 (26.3)
Positive reframing	266 (61.3)	168 (38.7)
Acceptance	128 (29.5)	306 (70.5)
Humor	378 (87.1)	56 (12.9)
Religion	346 (79.7)	88 (20.3)
Using emotional support	338 (77.9)	96 (22.1)
Using instrumental support	341 (78.6)	93 (21.4)
Self-distraction	287 (66.1)	147 (33.9)
Denial	411 (94.7)	23 (5.3)
Venting	389 (89.6)	45 (10.4)
Substance use	413 (95.2)	21 (4.8)
Behavioral disengagement	393 (90.6)	41 (9.4)
Self-blame	400 (92.2)	34 (7.8)

Data are presented in frequency (%).

TABLE 4 Aggregate scores for adaptive and maladaptive coping strategies.

Coping strategy	Category	All ($n = 434$) Results: Mean $\pm$ SD
Adaptive (item 1–8) [Total score = 32 x 2]	Mean $\pm$ Standard deviation	35.7 $\pm$ 9.4
	Median (Interquartile range)	35.0 (13.0)
	Range	16–64
Maladaptive (item 9–14) [Total score = 24 x 2]	Mean $\pm$ Standard deviation	19.3 $\pm$ 6.2
	Median (Interquartile range)	18.0 (7.0)
	Range	12–48

effects on mental health, both among the community as well as selective target populations. The reported prevalence of anxiety in the community varied from 31.9% (1) to 41.3% (37). An online survey among Malaysian university students, conducted during the first wave of the infection in early 2020 found that 20.4 percent reported minimal to moderate anxiety symptoms, while 6.6 and 2.8% reported marked to severe and extreme levels of anxiety respectively (35). In another cross-sectional survey conducted in China among college students in the midst of the outbreak in Wuhan, the reported rate of anxiety was 11.0% (38). In comparison, we found that 41% of our students experienced mild to moderate symptoms of anxiety (score of 1–8; CAS) and only 0.6% (score ≥ 9) had dysfunctional anxiety. The corresponding results among staff were 31.2 and 2.2% respectively.

Our study was conducted almost 1 year into the pandemic, amidst the third wave of COVID-19 in Malaysia. We found that a large proportion of the respondents in this study either reported absence of anxiety symptoms (60.1%) or mild to moderate anxiety (39.0%); only 4 individuals (0.9%) had symptoms indicative of dysfunctional anxiety. There was no significant difference between staff and students overall; however, the proportion of dysfunctional anxiety was higher among staff (2.2%) compared to students (0.6%). These results cannot be compared directly with those quoted; our study subjects are staff and students from a single privately run university in the Klang Valley in Malaysia. Secondly, the tool used for evaluation of the anxiety state is variable across studies. Further, the present study involves people who have gone through the initial wave of COVID-19 as well as several cycles of movement restrictions. Hence, the circumstances were also quite different. In addition, the university in question (UTAR) had been very proactive and had instituted relevant measures to inform, instruct, advice and support students and staff alike throughout the course of the COVID-19 outbreak. This is reflected in the high level of satisfaction with supportive measures provided. Hence, the relatively low numbers who experience dysfunctional anxiety. Nevertheless, the general consensus is that the pandemic has taken a toll on mental health and cause anxiety level to increase across all spectrums of society, albeit to different degree and extent.

Coping strategies

The Brief COPE was used as the tool to assess the coping methods preferred by respondents of this study; from the practical point of view, this tool is simple to administer

TABLE 5 Summary of result on anxiety level related to the COVID-19 pandemic ($n = 434$).

Assessment (minimum and maximum score)	Category	All ($n = 434$)	Staff ($n = 93$)	Students ($n = 341$)	p -values
Coronavirus Anxiety Scale (0–20)	Mean $\pm$ Standard deviation	1.1 $\pm$ 1.8	0.9 $\pm$ 1.9	1.1 $\pm$ 1.8	0.324
	Median (Interquartile range)	0 (1)	0 (1)	0 (2)	-
	Range	0–11	0–10	0–11	-
	No anxiety symptoms (Score = 0)	261 (60.1)	62 (66.7)	199 (58.4)	0.100*
	Mild-moderate anxiety (Score = 1–8)	169 (38.9)	29 (31.2)	140 (41.1)	
	Dysfunctional anxiety (Score ≥ 9)	4 (0.9)	2 (2.2)	2 (0.6)	

Data are presented either in mean $\pm$ standard deviation, median (interquartile range), range, or n (%).

* p -value of Fisher's Exact test.

and uses a fairly standard scoring procedure; further, it is a widely validated tool with good psychometric properties. The subscales can be conveniently classified into 2 or 3 categories; in this study we divided them into adaptive and maladaptive approaches (36). The most frequent coping method used by the respondents was acceptance (70.5%), followed by active coping (45.9%) and positive reframing (38.7%), all of which are considered to be adaptive coping practices. These 3 subscales also fall into the approach coping category based on the approach-avoidant 2-factor model. Self-distraction, a maladaptive form of coping was also frequently used (33.9%); this, according to the approach-avoidant model is an avoidant behavior. We note that the common models used for classification of coping styles are somewhat over-simplistic and that overlapping classification is frequent (39).

It is noteworthy that the proportion of respondents who frequently adopt maladaptive coping, with the exception of self-distraction, was quite low, ranging from 4.8% (substance use) to 10.4% (venting). In comparison, the proportion of respondents who use the various adaptive coping methods ranged from a low of 12.9% (humor) to a high of 70.5% (acceptance). It is observed that about a fifth (20.3%) of the respondents used religion, this is apparently more so among staff than students ($p < 0.001$); likewise, the use of positive reframing, an adaptive coping method ($p = 0.016$). It is acknowledged that coping is a rather complex process that is influenced by multiple factors underlying both the situational and dispositional coping responses. In this study, the situation underlying the stress posed is the COVID-19 pandemic and all its associated negative impacts, existential, psychological, social and economic. Overall, we observe positive coping in a relatively larger proportion of the university community, which we believe is related partly to the fact that, at least among staff, a stable job with an assured income and partly to the support that staff and students received from the university throughout the entire duration of the local outbreak to date.

The predictors of coronavirus-related anxiety

Multiple linear regressions indicated that maladaptive coping and presence of comorbidities are the significant predictors of coronavirus-related anxiety in this study. It is hypothesized that maladaptive coping strategies would lead to development of more prominent or severe pandemic-related psychological symptoms. This was confirmed in a study that demonstrated a strong association between the use of maladaptive coping strategies and anxiety symptoms in relation to the pandemic (40); in particular, self-blame was found to be related to more severe anxiety during the COVID-19 pandemic. In another study of the Australian population (41), low scores in the adaptive coping strategies, acceptance and instrumental support and high scores in the maladaptive coping strategies, behavioral disengagement and self-blame, were predictors of anxiety during COVID-19 pandemic. We did not find any significant association between adaptive coping and anxiety in this study. Some other studies have reported either the lack of or relatively weak association between adaptive coping strategies and anxiety (29–33). Interestingly, one of these studies (32) indicated that adaptive coping is associated with a higher level of subjective well-being, despite the presence of psychological disorders. However, we did not measure subjective well-being in this study, so we are unable to determine whether this is true in our case.

The finding in this study that comorbidities is a predictor of coronavirus-related anxiety is in accordance with that of a previous study (42) which found that people with underlying comorbidities are more likely to have high anxiety score than those without. This is not unexpected as it is widely known and accepted that people with comorbidities are at higher risk of morbidity and mortality from COVID-19; hence, the increased anxiety among this group of people (43).

Lastly, the majority of respondents indicated that that were compliant with recommended public health measures, and were satisfied with the support and resources provided by the

TABLE 6 Factors associated with Coronavirus Anxiety ($n = 434$).

	Simple linear regression Crude B coefficient (S.E.)	<i>p</i> -values	Multiple linear regression Adjusted B coefficient (S.E)	<i>P</i> -values
Age	−0.009 (0.010)	0.404	−0.017 (0.020)	0.395
Gender	0.259 (0.178)	0.147	0.320 (0.175)	0.068
(Females as indicator; Males as reference)				
Role		0.77		
Admin vs. Academic	−0.167 (0.292)	0.568	0.131 (0.446)	0.12
Student vs Academic	0.210 (0.213)	0.324	0.728 (0.467)	
Marital status		0.541		
Married vs. Single	0.031 (0.281)	0.913	0.283 (0.463)	0.985
Divorced vs. Single	−1.063 (1.289)	0.41	0.024 (1.321)	
Education level		0.259		
Secondary vs. Postgraduate	−0.005 (0.224)	0.982	−0.629 (0.556)	0.482
Diploma or Bachelor degree vs. Postgraduate	0.373 (0.361)	0.302	0.344 (0.489)	
Presence of comorbidities		0.116		
Unsure vs. None	0.658 (0.397)	0.098	0.606 (0.385)	0.025
With comorbidities vs. None	1.416 (0.609)	0.021	1.376 (0.610)	0.071
Zone of residence (Green zone as indicator; Not in green zone as reference)	0.493 (0.349)	0.159	0.610 (0.337)	0.866
Household size (Staying alone as indicator; Not staying alone as reference)	−0.281 (0.494)	0.57	−0.084 (0.499)	0.598
Living with children (With children as indicator; Without children as reference)	−0.089 (0.183)	0.629	0.098 (0.186)	0.22
Living with elderly (With elderly as indicator; Without elderly as reference)	0.252 (0.187)	0.177	0.224 (0.182)	0.284
Not satisfied with support and resources	−0.504 (0.229)	0.028	0.239 (0.223)	0.692
Compliance with preventive measures	−0.064 (0.088)	0.466	−0.037 (0.093)	0.168
Frequency of updating about COVID-19	0.127 (0.062)	0.041	0.083 (0.060)	0.709
Self-risk perception	0.040 (0.033)	0.221	0.012 (0.032)	0.102
Preparedness & perceive self-efficacy	−0.053 (0.051)	0.297	0.088 (0.053)	
Unwanted behavior	0.068 (0.026)	0.009	0.049 (0.026)	0.055
Adaptive coping	0.031 (0.009)	0.001	−0.005 (0.012)	0.646
Log ₁₀ transformed Maladaptive coping	4.439 (0.674)	<0.001	4.106 (0.902)	<0.001

The adjusted R-squared values for the independent variables included in the model for multiple linear regression (enter method) for the Coronavirus Anxiety was 0.111.

university during the pandemic. It might be surmised that this behavior and the satisfaction with support services are contributory to the very low frequency of dysfunctional anxiety and the relatively low frequency of anxiety symptoms among the respondents, staff and student alike. About one-tenth of respondents update themselves about the status of the COVID-19 pandemic several times a day, which could contribute to heightened anxiety reported by some respondents.

Implications

This study informs about the effect of the COVID-19 pandemic on the mental status of staff and students of a university community, and its

association with the coping methods employed. To this end, we employed the Coronavirus Anxiety Scale, a validated instrument to explore the anxiety level, and the Brief COPE to examine the coping styles favored among staff and students in the midst of the pandemic.

Limitations

This study is an observational study confined to a single university community, which limits the generalization of the results to other educational institutes. Secondly, participants might not be truly representative of the university community as a whole as they were recruited

via an online survey using universal sampling method. The Coronavirus anxiety scale used is based on reported symptoms of anxiety and provided only 2 classifications—mild anxiety (score 0–8) and dysfunctional anxiety (score ≥ 9). The factors associated with anxiety were not examined in detail as the number of subjects who reported severe or dysfunctional anxiety was too few.

Further, it is acknowledged that the Brief-COPE instrument has not been adequately validated in the Malaysian population and so it is not known how well the latent constructs of adaptive and maladaptive coping strategies translate to actual coping ability. Therefore, further validation studies with larger sample size and representative sampling methods are warranted, to allow for more in-depth appropriate and comprehensive analyses that may verify these findings.

We are also cognisant of the fact that during the pandemic, travel and social activities were extremely restricted. It is likely that many would spend more time on smartphones and the internet; appropriate use of smartphones and the internet could provide the means for handling the distress due to these restrictions (44). However, inappropriate use or overuse of the smartphone and internet, in particular to the extent of addiction could conversely exacerbate distress and coronavirus-related anxiety (45). However, we did not capture the pattern of smartphone and internet use in this study; therefore, the results on this aspect should be interpreted with this limitation in view.

Conclusion

A high score for maladaptive coping and presence of comorbidities were the predictors of coronavirus anxiety. Dysfunctional anxiety among the UTAR community, a not-for-profit private university situated in the Klang Valley, Malaysia is very low at <1 percent. This is believed to be reflective of the high level of satisfaction with the support and services provided during the COVID-19 outbreak. With respect to coping methods employed during the outbreak, it was found that adaptive coping methods were used a lot more frequently by both staff and students. Nevertheless, the study has identified small numbers of people who practice maladaptive coping behavior which can act as prompts for appropriate action/intervention.

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 Universiti Tunku Abdul Rahman's Scientific and Ethical Review Committee. Ethics approval number: U/SERC/138/2020. The patients/participants provided their written informed consent to participate in this study.

Author contributions

Conceptualization and methodology: KWL, SFY, HTO, and MSL. Data curation: MSL. Formal analysis and writing—original draft: KWL, SFY, and MSL. Funding acquisition: SFY. Investigation: KWL, SFY, HTO, KSP, and MSL. Project administration and resources: HTO. Software: KWL and KSP. Supervision: SFY and MSL. Validation: KSP and MSL. Visualization: KWL. Writing—review & editing: KWL, SFY, KSP, and MSL.

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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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Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpubh.2022.936486/full#supplementary-material>

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What drives people's protective behaviors during the early stage of the COVID-19 pandemic in China

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This study systematically examined people's protective behaviors against COVID-19 in China, and particular attention was given to people's perceived threat and information-processing strategies. This study constructed a conceptual model and used structural equation modeling to explore this issue, and a questionnaire survey was conducted to collect data involving 4,605 participants during the early stage of the COVID-19 pandemic in China. The results showed that people's initial information acquisition played an essential role in their behavioral responses; acquiring more initial information about COVID-19 would make them perceive a higher threat and present a higher demand for information, then making them more likely to seek and process information, and subsequently motivating their protective behaviors. In addition to increasing people's information needs, the perceived threat could also strengthen the analytical assessment and affect protective behavior positively but failed to predict the experiential assessment. Driven by information need, information seeking significantly influenced protective behavior; it also facilitated analytical assessment and decreased experiential assessment, thus predicting people's protective behaviors. Protective behaviors were spurred by analytical assessment but negatively influenced by the experiential assessment.

KEYWORDS

COVID-19, protective behavior, perceived threat, information seeking, information-processing strategy

Introduction

At the end of 2019, the novel coronavirus disease (COVID-19) outbreak began in Wuhan. This potentially fatal infectious disease was characterized by a steady speed of spread and transmitted from human to human through respiratory droplets or direct contact (Ranjit et al., 2021). The World Health Organization (WHO) classified it as a pandemic on 11 March 2020. In the past 2 years, the COVID-19 pandemic has affected most countries worldwide and caused a heavy loss of both life and economy. The Chinese government took many measures to curb the spread of COVID-19 and achieved staged

success in the fight against this disease. There was no doubt that public compliance with practical health proposals was crucial in achieving this success.

The COVID-19 pandemic not only affected daily life and the economy but also shaped people's behavior. Generally speaking, a significant crisis event reflects people's historical experience and new characteristics in dealing with risk situations. Mainly, due to the lockdown policy, people live in a virtual environment built by information media, and risk information profoundly shapes the dimensions of people's protective behaviors. Some people took positive action based on best practice guidelines, and some people failed to engage in protective behaviors. The variation in citizen response suggests that it is timely to explore the formation mechanism of people's protective behaviors in the COVID-19 pandemic.

The unpredictable outbreak of COVID-19 has motivated studies of disease protective behaviors last year. For example, based on comparative analysis, a survey conducted by [Ye et al. \(2020\)](#) compared the adoption of basic, advanced, and excessive preventive behaviors in different groups of demographic characteristics. [Liu and Mesch \(2020\)](#) investigated factors related to the adoption of social distancing behaviors in China and Israel from the perspective of cultural differences. [Chen and Chen \(2020\)](#) compared prevention behaviors between urban and rural residents in China. [Meier et al. \(2020\)](#) compared public belief in the effectiveness of protective measures in the Netherlands, Germany, and Italy. Meanwhile, based on the theoretical foundation of cognitive behavior, some scholars explored the influencing factors associated with adopting preventive behaviors. For example, [Storopoli et al. \(2020\)](#) examined how personal cognition shaped prevention behaviors by applying the recreation theory. Taking the protection motivation theory as the basic framework, [Barati et al. \(2020\)](#) tested the relationship between threat perception, coping appraisal, and prevention behavior.

Although previous studies have made substantial contributions to the protective behaviors against COVID-19, most of the conclusions were based on a single theoretical framework and comparative analysis. Most importantly, the information-processing strategies influencing the protective behaviors were still not clearly defined. Thus, a study exploring the formation mechanism of people's protective behaviors is needed. This is especially true in China, where the COVID-19 outbreak began and aroused widespread concern. To address these issues, we constructed a conceptual model to better explain people's protective behaviors and help public sectors improve behavior through the policy effectiveness of behavior guidance.

Theory and hypotheses

The protective action decision model (PADM) proposed by is an essential framework for explaining people's protective action decisions in response to imminent disasters or long-term hazard adjustments. The PADM emphasizes that people exposed to a

potential risk receive risk information from outside and that the resulting risk perception is derived from the combination of that information. It also brings attention to people's behavioral reactions intended to remove uncertainty about the risk and take appropriate protective actions. In the PADM, protective action decision-making begins with environmental cues, social cues, and warnings. This information initiates a series of pre-decisional processes that, in turn, elicit core perceptions of the ecological threat, alternative protective actions, and relevant stakeholders. These perceptions provide the basis for protective action decision-making, the outcome of which combines with situational facilitators and impediments to produce a behavioral response. The response can be information search, protective response (problem-focused coping), or emotion-focused coping. As the research stream evolved, a more recent version of PADM takes account of some other factors and integrates information flow into the model ([Lindell and Perry, 2012](#)). The new updated PADM indicated that some people who receive a warning might find that the available information is insufficient to justify a protective action positively. When they think time is available, people cope with the lack of knowledge by searching for additional information, and people commonly need additional information about the threat's certainty, severity, and immediacy. The information search process begins with an information needs assessment arising from an individual's judgment that the available information is insufficient to justify proceeding further in the protective action decision process. The PADM provides a systematic and comprehensive idea for understanding people's protective behaviors under the risk situation of COVID-19. However, the PADM does not characterize information-processing strategies in detail. This is of particular importance to understanding protective behaviors because COVID-19 is a new risk situation and is not yet fully understood by people. Thus, the information-processing strategies of protective behaviors should be explained clearly.

In attempting to evaluate information to arrive at a judgment, the heuristic-systematic information-processing model (HSM) presents a careful understanding of these issues. According to the HSM, the strategy that people select to process information includes a dual-process model of systematic processing and heuristic processing, and this strategy makes a big difference in what individuals take away from these messages about risk and might affect their risk judgment. Systematic processing occurs when individuals make a judgment by carefully examining, comparing, and relating arguments; individuals usually require the information quality to meet higher standards before making a decision. On the contrary, heuristic processing occurs when individuals use simple decision rules to help them arrive at a judgment about the validity of a message. Individuals may spend less effort and fewer resources and often easily accept the information they hold or acquire from outside without questioning. Similarly, [Slovic and Peters \(2006\)](#) indicated that individuals have two modes of risk information assessment: analytical assessment and experiential assessment. The analytical

assessment concludes with information integration and logical analysis, while the experiential assessment uses simple rules to arrive at a judgment (Slovic and Peters, 2006).

Two modes of information-processing work simultaneously or individually, and information sufficiency determines the two different processing modes. People are more motivated to use systematic processing or analytical assessment to choose subsequent behaviors if they have sufficient professional information. In contrast, limited information is an antecedent of heuristic processing or experiential assessment. Recently, scholars continually perfected information processing by integrating various behavioral theories and models into the original model. The risk information-seeking model (RISM) proposed by Griffin et al. (1999) further explained the phenomenon of purposeful seeking for specific information to make correct behavior decisions. Wei et al. (2016) and Zhu et al. (2016) integrated the RISM into the HSM and assumed information seeking and information need are the starting point and the internal driving force for information processing.

In addition, the mindsponge information-processing framework (MIPF for short) is also helpful for exploring the formation mechanism of protective behavior against COVID-19. The MIPF proposed by Vuong explains how a person receives and evaluates (filters) the information, accepts or rejects values, and updates related beliefs and behaviors in the process. Mindsponge is not only a coping mechanism aiming to solve internal conflicts but also a more inclusive model of cognition and behavior shifting process. The MIPF assumed that every person has a mindset consisting of a set of core cultural values or beliefs, which defines the person's identity, perceptions, and behaviors (Vuong and Napier, 2015). The mindset is surrounded by a comfort zone driven by a multi-filtering information process detecting and connecting information. When information from the external environment enters the comfort zone, here the information is evaluated by the filtering system, information availability/accessibility and subjective cost-benefit judgments are the two fundamental conditions for a new piece of information to

be accepted into the mindset (Nguyen et al., 2021). If both the objective availability and perceived accessibility of the information are guaranteed (the information needs to exist, be reachable, and be considered reachable to be received by the mind), it has to go through the cost-benefit judgments based on references of existing trusted values from the mindset including both rational and emotional-through many layers (Vuong et al., 2022a). The mindset absorbs and ejects information for the purpose of maximizing total perceived benefit and reducing total perceived cost for an individual. Information accepted into the mindset is integrated into one's belief system and will affect subsequent decisions. If the information is accepted, it can move into the mindset and become a new trusted value. If the accepted information directly corresponds to a behavior (whether mental or physical), then that behavior will be carried out (Nguyen et al., 2021; Vuong et al., 2022a).

The mindsponge information-processing framework (MIPF) provides us with comprehensive insight into the protective behavior under the COVID-19. According to the MIPF, if a person is accessible to COVID-19 information, they may perceive risk caused by the virus (perceived threat or cost). When the information about the COVID-19 acquired by people is absorbed into the mindset, the value judgment and relevant behavior principles contained in the information about the epidemic will become the updated core beliefs in the mindset; then, it will influence the subsequent information processes and behaviors. For example, it may increase people's demand for information and encourage people to seek more useful information related to COVID-19; it could also make people more cautious about the information and more rational in analyzing the information and then carrying out positive protective behaviors relatively (Vuong, 2022).

After the model combination and integration, we constructed the conceptual model (shown in Figure 1). This model adapts and synthesizes components from the PADM, HSM, RISM, and MIPF. Most variables were directly chosen from the applied models or replaced with relevant variables to fit the COVID-19 situation. The

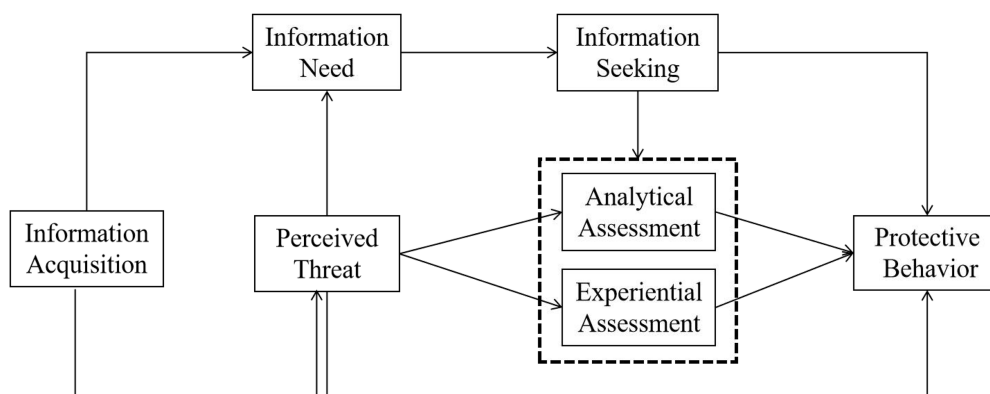


FIGURE 1
Conceptual model.

model assumes that people's information acquisition and perception of risk simultaneously trigger information need and information seeking. Subsequently, two information-processing mechanisms are stimulated. Finally, people produce protective behaviors. The proposed hypotheses are presented in Table 1 and discussed in more detail as follows.

Information acquisition and Perceived threat

According to the PADM, some environmental cues, social cues, and socially transmitted warnings that people acquire are the initial factors of the information-processing chain associated with protective behaviors (Lindell and Perry, 2012). The transmission of risk information is based upon a six-component communication model of "source-channel-message-receiver-effect-feedback". In the COVID-19 crisis, people acquired a certain amount of risk information through public sectors, traditional media, new media, and interpersonal channels. The data were generally fragmentary; the accuracy of the message may be less than desired.

In the PADM, risk perception is a central factor influencing people's responses to threatening events (Lindell and Perry, 2012). Here, we developed a similar concept, "perceived threat" as an essential predictor of individuals' behavioral reactions to adjusting to COVID-19; perceived threat denotes people's initial perceptions about the threats caused by the adverse physical and social impacts. Many researchers have proved that information acquisition was a predictor of perceived threat (Brenkert-Smith et al., 2013; Wachinger et al., 2013), emphasizing perceived threat refers to people's expectations of the personal impacts of a risk situation (Slovic and Peters, 2006), including risk-consequence perception, risk-probability perception, and risk-proximity perception (Lindell and Hwang, 2010; Yue et al., 2011). Perceived threat is not only a relatively subjective concept but is also highly correlated with uncertainty about the expected results. When people are exposed to certain risk information for a long time, individuals' expectations related to the likelihood of personal physical and social impacts may be surrounded by an extensive and long-term perception of risks. These expected impacts include death, injury, property damage, and disruption to daily activities such as work, school, and shopping. Thus, we develop the following hypotheses:

H1: people who acquired more information about COVID-19 perceived more threat

Information need and information seeking

Information need (IN) refers to the perceived gap between the sufficiency threshold of information required for specific goals

and the amount of currently held information (Huurne and Gutteling, 2008). As the result of professional barriers, information asymmetry, and cognitive constraints, the information gap makes it difficult for people to evaluate COVID-19. People may need more information about the progress of the crisis to help assess risk. As they acquire more and more knowledge, people may hope that society can provide more up-to-date information through official or other channels. So people usually try to fill this gap by getting more information through different information sources because people who feel threatened often want to accurately assess the threat with information at a higher quality level (Lindell and Prater, 2010). Sufficient information can reduce the cognitive cost of using information and increase the benefit of obtaining it. Hence, the following hypotheses are proposed:

H2: people who acquired more information about COVID-19 have stronger information need

Meanwhile, the perceived threat is essential for predicting individual behavioral responses. People's initial threat perception could lead to an increased feeling of uncertainty. This may make people aware that their information is insufficient in quantity and quality and motivate people to seek additional information to clearly understand the threat (Yue et al., 2011). Most previous studies confirmed threat perception was a driving force for information needs (Prati and Zani, 2013; Wang et al., 2016; Iwona et al., 2019). In the risk situation of COVID-19, people's threat perception generally increases the feeling of fear and anxiety. They may desire to obtain more available information to justify an appropriate protective action, thus motivating them to seek additional information and logistical support for other protective behaviors. So the following hypotheses are proposed:

H3: people who perceived more threat about COVID-19 tend to present higher information need

Furthermore, many studies have explained the relationship between information need and information seeking. Just as the updated PADM mentioned, people who encounter a risk might find that the available information is insufficient to assess the risk and justify an appropriate protective behavior. This information gap is viewed as the key motivator for information seeking (Lindell and Perry, 2012). If people realize the available information was insufficient to assess risks, they may search for additional information about the threat's certainty, severity, and immediacy. In the HSM, information need is also the motive force of information search (Wei et al., 2016). Griffin et al. (2008) used information insufficiency to describe the gap between individuals' information held and their information needed and defined information seeking as the efforts of individuals to gather information. Many studies supported information need positively affects information seeking (Griffin et al., 1999; Moore, 2002; Huurne and Gutteling, 2008; Dunwoody and Griffin, 2014). In the COVID-19 crisis, people need more information about the epidemic's progress due to the

stay-at-home policy, hoping to acquire more timely information through various channels. Therefore, the following hypotheses are developed:

H4: people who exhibit higher information need about COVID-19 tend to exhibit higher information seeking

Analytical assessment and experiential assessment

The HSM views information processing as an antecedent to attitude formation and behavior change and hypothesizes that people process information using the strategies of systematic processing and heuristic processing. Slovic and Peters (2006) used analytical assessment (effortful) and experiential assessment (superficial) instead of HSM to describe these information-processing strategies. Analytical assessment is the logical evaluation and comprehensive comparison with which individuals make judgments. On the contrary, the experiential assessment works when individuals use simple rules to help them arrive at a decision. There are many factors affecting people's information-processing strategies. Information sufficiency is considered the essential determinant (Kahlor et al., 2010). When individuals carry sufficient information, they are more motivated and able to analyze the information related to this issue. On the contrary, insufficient information is a vital stimulant to the experiential assessment, and people who hold less information are more likely to process information rely on emotion and experience cues (Trumbo, 2010; Trumbo et al., 2010). However, this relationship has not been confirmed in the risk scenario of COVID-19; whether or not information seeking affects people's information-processing strategies is yet to be determined. Therefore, the related hypotheses are developed:

H5: people who seek more information about COVID-19 are more likely to process information using analytical assessment

H6: people who seek less information about COVID-19 are more likely to process information using the experiential assessment

There are few studies on people's risk perception influencing information-processing strategy. Hovick et al. (2011) examined the indirect effects of risk perception on systematic processing; the direct relationship is unclear in a particular risk situation. Wei et al. (2016) linked risk perception with systematic processing in the issue of the Volkswagen crisis and indicated risk perception is the key motivator for individuals to process information systematically, but in an inevitable public health crisis, the comprehensive relationships are still not defined clearly. When people are exposed to a risk, higher levels of threat perception motivate them to seek more information and increase their intentions to evaluate the risk further. This evaluation usually requires them to analyze the information with more effort. When people face the situation of

COVID-19, the initially perceived threat increases the degree of the perceived threat and affects their intentions to adopt different information-processing strategies (Shadmi et al., 2020). Generally, people who have perceived more threats know more about COVID-19 and have an advantage in analytical thinking and logical reasoning when making protective behavior decisions. In comparison, people who perceive more minor threats are easier to draw a protective behavior decision through personal experience, emotion, and recommendations from others. Higher threat perception may inspire people's analytical assessment, and the experiential assessment processing will be conserved. Therefore, the following hypotheses are developed:

H7: People who perceived higher threat about COVID-19 are more likely to process information using analytical assessment

H8: People who perceived lower threat about COVID-19 are more likely to process information using experiential assessment

Protective behavior

Previous studies have already conducted an in-depth summary of people's protective behaviors from the perspective of concept classification. Part of the findings reached a uniform conclusion, and some differed from others (Terpstra and Gutteling, 2008; Lindell and Perry, 2012). Many studies have identified that individuals who seek more information exhibited higher intentions to take protective behaviors for keeping themselves away from risk (Burton et al., 1993; Wei et al., 2016). In COVID-19, information asymmetry makes people search for more information and conduct an overall weighted evaluation of the severity of the epidemic, then motivating them to adopt protective behaviors to avoid risk positively. Therefore, the following hypothesis is developed:

H9: people who seek more information about COVID-19 are more likely to take protective behavior

However, few studies explain the impact of information-processing strategies on behavioral response. In particular, the effects of analytical assessment and experiential assessment on protective behavior have not been compared in a specific risk situation. Hovick et al. (2011) tested the relationship between systematic processing and protective behavior in a health crisis, and they concluded that people usually show positive health-protective actions with analytical assessment. In many other risk situations, information processing has also been identified in that individuals who process information with logical evaluation exhibit higher intentions to take actions to avoid the risk. In general, analytical assessment is driven by sufficient information and is conducted by analyzing and comparing, and then motivating people to take protective behaviors against COVID-19. The experiential assessment means an automatic processing strategy in which individuals

TABLE 1 Developed hypothesis and causal relationships.

Hypothesis	Causal relationships			Developed hypothesis
H1	PT	←	IA	People who acquired more information about COVID-19 perceived more threat
H2	IN	←	IA	People who acquired more information about COVID-19 have stronger information need
H3	IN	←	PT	People who perceived more threat about COVID-19 tend to present higher information need
H4	IS	←	IN	People who exhibit higher information need about COVID-19 tend to exhibit higher information seeking
H5	AA	←	IS	People who seek more information about COVID-19 are more likely to process information using analytical assessment
H6	EA	←	IS	People who seek less information about COVID-19 are more likely to process information using experiential assessment
H7	AA	←	PT	People who perceived higher threat about COVID-19 are more likely to process information using analytical assessment
H8	EA	←	PT	People who perceived lower threat about COVID-19 are more likely to process information using experiential assessment
H9	PB	←	IS	People who seek more information about COVID-19 are more likely to take protective behavior
H10	PB	←	AA	People who process information using analytical assessment are more likely to take protective behavior
H11	PB	←	EA	People who process information using experiential assessment are less likely to take protective behavior
H12	PB	←	PT	People who perceived higher threat about COVID-19 are more likely to take protective behavior

respond to a stimulus without sufficient information and can be viewed as a lack of additional efforts and using experience, emotion, and following to evaluate, quickly leading to fewer sound judgments and negative protective behaviors when facing the COVID-19. Therefore, the following hypotheses are developed:

H10: people who process information using analytical assessment are more likely to take protective behavior

H11: people who process information using experiential assessment are less likely to take protective behavior

Perceived threats are believed to be crucial for people's protective behavior. Most research on disasters has found that threat perception predicted warning responses, such as evacuation (Sorensen, 2000) and long-term risk adjustments (Lindell, 2013). These protective responses have been studied for hazards such as earthquakes, hurricanes, other coastal storms, floods, and volcanic eruptions (Dash and Gladwin, 2007). In this study, we plan to expand these studies in the context of COVID-19 and examine whether a perceived threat influences people's protective behaviors. Therefore, the following hypothesis is developed:

H12: people who perceived higher threat about COVID-19 are more likely to take protective behavior

Materials and methods

Survey

To explore people's protective behaviors against COVID-19, we conducted an online survey through Wenjuanxing, the most popular online survey platform in China. The questionnaire consisted of three parts: an introduction page, a variable page, and a socio-demographic characteristics page. After a brief introduction to thank respondents for their participation, some basic scenario information that introduced the progress and uncertainties of

COVID-19 was presented. Then, a section of items was designed to identify scales of constructs. Finally, some questions investigating demographics were in the last section. The questionnaire was written in Chinese; although it was developed in English, we invited four bilingual risk researchers to help us translate it into Chinese and back-translate it into English. By comparing the different versions, we modified and deleted the contents that did not fit Chinese habits and culture to ensure the content validity of our questionnaire. Before the formal investigation, a pre-survey with a convenience sample of 110 students was conducted for further checking and refining the scenario information and measures. The duration of whole investigation process lasted from 15 February to 20 February 2020. A random sample of 5,780 respondents was interviewed online, 1,175 responses were invalid due to missing data, and the participants did not recognize two inverse questions embedded in the questionnaire; 4,605 valid questionnaires were used in this study.

Table 2 shows the summary statistics of socio-demographic characteristics of respondents, including gender, age, education, and registered residence. The gender ratio is almost equal, with 47.1% ($N = 2,170$) percent of the sample being male and 52.9% ($N = 2,435$) being female. As for the age distribution, the largest groups are between 21 and 30 (36.4%, $N = 1,675$) and 31 and 40 (40.9%, $N = 1,685$), followed by 6.2% ($N = 285$) of those respondents are under 20 years old, 13.2% ($N = 610$) are between 41% and 60%, and 3.2% ($N = 150$) are over 50 years old. In terms of education, the respondents are relatively well-educated, over half of the respondents (79.1%, $N = 3,645$) completed their college program, followed by a Master's degree or above 13.9% ($N = 640$), and a small portion of the respondents (6.9%, $N = 330$) are high school or below. Finally, the registered residence falls into rural with 50.5% ($N = 2,325$) and urban with a percentage of 49.5% ($N = 2,280$).

Measures

The measurement scale used in this study contained seven constructs, each of the variables was measured with multiple items

TABLE 2 Demographic profile of respondents (N=4,605).

Variables	Category	Frequency	Percentage (%)
Gender	Male	2,170	47.1
	Female	2,435	52.9
Age	20 or below	285	6.2
	21–30	1,675	36.4
	31–40	1,685	40.9
	41–50	610	13.2
	50–60	135	2.9
	61 or above	15	0.3
Education	Primary school and below	25	0.5
	junior middle school	95	2.1
	High school	200	4.3
	University(College)	3,645	79.1
	Master degree or above	640	13.9
Registered residence	Rural	2,325	50.5
	urban	2,280	49.5

based on previous literature and modified to fit the context of COVID-19 with a seven-point Likert scale.

In this paper, information acquisition is the initial amount of information related to COVID-19 people acquired from multiple channels. We measured people's information acquisition using five items modified from the work of Pang (2020). People were asked how often they have heard about COVID-19 from the government, experts, family or friends, and traditional media (TV, newspaper, and radio), and how much information they have received from traditional media (TV, newspaper, and radio) and new media. In addition, the scores of all items varied from "never" to "very often" with a 7-point Likert scale.

Information need was measured by three items using a subjectively selected subset of items modified from Huurne and Gutteling (2008), and the measurement included "knowing more information about COVID-19 is necessary," "I want more information related to COVID-19," and "I hope to obtain a comprehensive understanding of COVID-19 through multiple channels." The measurement of information seeking was also based on previous research conducted by Huurne and Gutteling (2008). The items mainly reflected the following three aspects: "It is necessary to search for information related to COVID-19," "I am very pleased to search for information about COVID-19," and "I search for comprehensive information about COVID-19 through multiple channels." Perceived threat is the most critical construct to examine how people understand the risks of COVID-19, and people are more likely to focus on the perceived degree of consequence, probability, and proximity (Lindell and Hwang, 2010; Yue et al., 2011). Thus, in this study, we measured perceived threat by three items modified from Ranjit et al. (2017). The measurement was described as follows: "I am susceptible to getting COVID-19," "I think COVID-19 poses a serious threat to my health," and "I feel the virus is very close to me." People could answer on a 7-point Likert scale ranging from "totally disagree" to "totally agree."

The analytical assessment was measured through three items based on Slovic and Peters's definition, and the items were

listed as follows: "I learned about COVID-19 through a comparison of relevant information," "I learned about COVID-19 by thinking about the most scientific information," and "I tried to link this information with my major and interests." As for measuring the experiential assessment, we also used Slovic and Peters's (2006) concept as needed for our context, and the items were shown as follows: "I exerted little effort in learning about COVID-19," "I formulated my judgments on COVID-19 by following the comments of others," and "I made a risk evaluation on COVID-19 according to the intuition." All items were measured on a seven-point Likert scale from "totally disagree" to "totally agree."

The measurement of protective behavior is based on Lindell and Perry's (2012) initial definition of coping behavior and adapted them to certain risk situations COVID-19. These items were measured as follows: "I wear masks and goggles when going out," "I store enough protective equipment (e.g., masks, alcohol, food)," "I reduce contact with others," "I spread scientific epidemic prevention knowledge to others," "I put forward suggestions to the government for epidemic prevention," and "I donate prevention equipment to the epidemic areas." All measures were completed on seven-point Likert scales, where 1 indicated strong disagreement and 7 told strong agreement.

Data analysis

Before empirically testing the measurement and structural models, our constructs' descriptive statistics and correlations are presented in Table 3, including means (the means of the items), standard deviation, and correlation. The results reveal that people also expressed a strong need to search for more information ($M = 5.86$). Meanwhile, compared with empirical assessment ($M = 4.97$), people had a relatively high dependence on analytical assessment ($M = 5.74$) and placed a high value on the threat of COVID-19 ($M = 4.98$), and finally had a relatively high degree of protective behavior when facing the epidemic ($M = 5.25$). For the correlations between various constructs, the correlation analysis results verify the relationship assumed by the conceptual model, and it is appropriate to conduct further analysis.

According to known procedures, the data analysis consists of two stages. First, a measurement model was created and estimated by confirmatory factor analysis (CFA) to determine whether the questionnaire items measured their intended constructs correctly, namely the reliability and validity tests. In the second stage, when measurement quality was confirmed, a structural model was established and conducted with SEM analysis to verify the hypothesized relationships of the proposed model under the condition of a satisfactory measurement model. Confirmatory factor analysis (CFA) was implemented to evaluate the adequacy of the measurement model.

As shown in Table 4, the reliability and validity results showed that the composite reliability values were over the threshold value

TABLE 3 Means, standard deviation, and correlation.

M	5.15	6.00	5.86	4.98	4.97	5.74	5.25
SD	1.03	1.05	1.11	1.27	0.91	0.95	0.86
Correlation	IA	IN	IS	PT	EA	AA	PB
IA	1						
IN	0.487***	1					
IS	0.546***	0.791***	1				
PT	0.148***	0.191***	0.158***	1			
EA	−0.355***	−0.369***	−0.373***	−0.179***	1		
AA	0.415***	0.510***	0.470***	0.185***	−0.379***	1	
PB	0.192***	0.299***	0.270***	0.086**	−0.215***	0.219***	1

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.001$.

TABLE 4 Confirmatory factor analysis results for measurement model.

Constructs	Labels	Loadings	CITC	CR	Cronbach's α	AVE
Information acquisition	IA1	0.782***	0.789	0.924	0.819	0.945
	IA2	0.841***	0.764			
	IA3	0.868***	0.751			
	IA4	0.811***	0.795			
	IA5	0.835***	0.819			
Information need	IN1	0.948***	0.918	0.933	0.942	0.956
	IN2	0.971***	0.876			
	IN3	0.924***	0.952			
Information seeking	IS1	0.945***	0.907	0.917	0.936	0.936
	IS2	0.967***	0.868			
	IS3	0.918***	0.947			
Perceived threat	PT1	0.849***	0.813	0.906	0.845	0.916
	PT2	0.867***	0.836			
	PT3	0.814***	0.786			
Analytical assessment	AA1	0.839***	0.813	0.914	0.838	0.929
	AA2	0.878***	0.837			
	AA3	0.867***	0.822			
Experiential assessment	EA1	0.891***	0.852	0.937	0.843	0.941
	EA2	0.890***	0.858			
	EA3	0.876***	0.843			
Protective behavior	PB1	0.801***	0.827	0.922	0.860	0.932
	PB2	0.898***	0.858			
	PB3	0.914***	0.885			
	PB4	0.876***	0.845			
	PB5	0.880***	0.834			
	PB6	0.871***	0.893			

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.001$.

of 0.70. Cronbach's coefficients were over the threshold value of 0.70 significantly. The CITCs of all items satisfied the general recommended level of 0.70. Standardized loading was greater than 0.7, and the value of p was significantly related to its latent construct ($p < 0.001$). All AVEs were more than 0.5, and the square root of AVEs was greater than the cross-correlations between constructs. Thus, we can conclude that the measurement model had adequate reliability and validity. As shown in Table 5, the goodness-of-fit measures for the overall confirmatory model indicated that the

chi-square ratio, REMSEN, GFI, CFI, PGFI, PNFI, PCFI, AGFI, TLI, and NFI were also over the threshold. Thus, the findings indicate that the conceptual model satisfactorily fits the data.

Results

As shown in the structural model results in Table 6 and Figure 2, the result revealed that the model's performance effectively supported

the conceptual model; all but two paths (H8) achieved statistical significance at the level of 0.1 or better.

The overall model showed that the path from information acquisition to the perceived threat was statistically significant ($\beta = 0.209$, $p < 0.001$), and this result indicated confirmatory evidence for H1. In the case of the relationship between information acquisition, information need, and information seeking, the empirical results showed that the influencing path from information acquisition to information need ($\beta = 0.896$, $p < 0.001$) and the path from the information need to information seeking ($\beta = 0.791$, $p < 0.001$), just as expected, were positive signs, and both H2 and H4 were confirmed statistically.

As for the impact of perceived threat on information need, statistics suggested a significant influence path ($\beta = 0.096$, $p < 0.05$), and H3 was supported as predicted. Concerning the impact of information seeking on information-processing strategy in the formation of protective behavior toward COVID-19, the paths from information seeking to analytical assessment ($\beta = 0.424$, $p < 0.001$) and experiential assessment ($\beta = -0.249$, $p < 0.001$) were predicted to be positive and negative, respectively, and the results confirmed the authenticity of H5–H6. The predictors of

information processing showed that perceived threat also played an important role. The result showed that perceived threat had significantly positive influences on analytical assessment ($\beta = 0.264$, $p < 0.001$), whereas failing to predict the experiential assessment ($\beta = -0.020$, $p = 0.309$) substantially, so the hypothesis H7 was supported in the model, while H8 was not confirmed.

Finally, we found that information seeking was positively related to people's protective behaviors, and H9 was supported with a significant coefficient ($\beta = 0.180$, $p < 0.001$). Furthermore, the analytical assessment had significantly positive influences on protective behaviors ($\beta = 0.107$, $p < 0.05$), while the experiential assessment showed hostile relations ($\beta = -0.212$, $p < 0.001$), perceived threat appeared to have significantly positive influences on people's protective behavior ($\beta = 0.134$, $p < 0.05$), and H10–H12 were supported as the conceptual model expected.

Discussion

The PADM, HSM, RISM, and MIPF have unique advantages in explaining people's protective behaviors and laid a stable theoretical foundation for exploring the formation mechanism of protective behavior against COVID-19. Based on the above theories and models, this study constructed a conceptual model and systematically examined the formation mechanism of people's protective behaviors in the COVID-19 pandemic, and particular attention was given to perceived threat and information processing. The main findings and innovative insights were discussed in the following.

Unlike many previous studies that pay attention to subjective or objective knowledge (Yechiel et al., 2009; Soffer et al., 2010; Fitch-Martin et al., 2018), this study examined the initial information acquisition played in people's protective behaviors, which many scholars have ignored. Although this study was the first to explore the influence of information acquisition on the formation of defensive behaviors in the public health crisis of

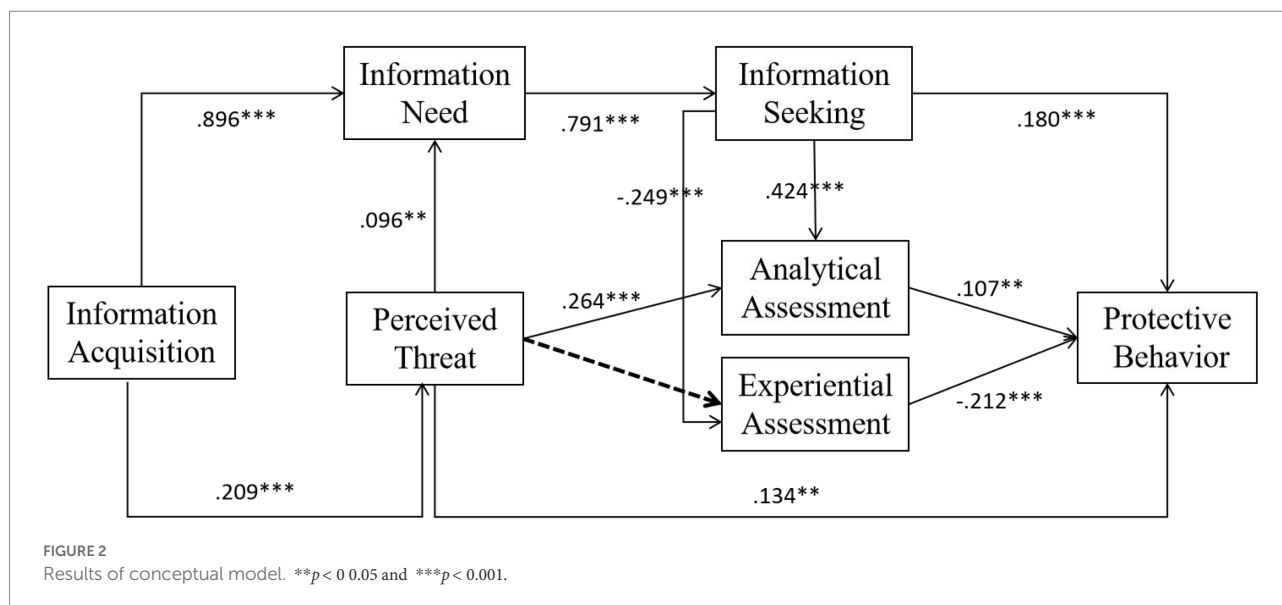
TABLE 5 Goodness-of-fit statistics for structural model.

Index		Threshold	Acceptance
χ^2/df	3.335	<5.0	Passed
RMSEA	0.051	<0.08	Passed
GFI	0.903	>0.9	Passed
PGFI	0.502	>0.5	Passed
AGFI	0.906	>0.9	Passed
TLI	0.908	>0.9	Passed
CFI	0.919	>0.9	Passed
NFI	0.908	>0.9	Passed
PNFI	0.513	>0.5	Passed
PCFI	0.524	>0.5	Passed

TABLE 6 Results of structural equation modeling.

Hypothesis	Causal relationships			Estimate	SE	P	Supported (YES/NO)
H1	PT	←	IA	0.209	0.041	<0.001***	YES
H2	IN	←	IA	0.896	0.082	<0.001***	YES
H3	IN	←	PT	0.096	0.047	0.021**	YES
H4	IS	←	IN	0.791	0.024	<0.001***	YES
H5	AA	←	IS	0.424	0.032	<0.001***	YES
H6	EA	←	IS	−0.249	0.027	<0.001***	YES
H7	AA	←	PT	0.264	0.040	<0.001***	YES
H8	EA	←	PT	−0.020	0.020	0.309	NO
H9	PB	←	IS	0.180	0.040	<0.001***	YES
H10	PB	←	AA	0.107	0.051	<0.001**	YES
H11	PB	←	EA	−0.212	0.057	<0.001***	YES
H12	PB	←	PT	0.134	0.044	0.005**	YES

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.001$.



COVID-19, the findings concluded that information acquisition was a critical predicting factor of information need, and people with more information acquisition about COVID-19 increased their desire for more information.

COVID-19 was a fatal infectious disease; people usually cared about the influence on their daily lives, the chance of being infected, and how far the threat was from oneself. Our findings confirmed that people with more information acquisition could perceive a higher threat level associated with COVID-19. It should also be noted that people who perceived a higher threat of this epidemic were more likely to present a higher demand for information and then inspire their intentions to seek more information related to COVID-19 for further risk judgment. This finding revealed that information need was a significant predictor of information seeking because COVID-19 was considered extremely dangerous; people who lacked sufficient information to assess the overall risk of the epidemic preferred to obtain more information and then showed motivation to seek additional information. These results were consistent with previous studies (Huurne and Gutteling, 2008; Wei et al., 2017).

In addition, this study divided information-processing strategies into two strategies: analytical assessment and experiential assessment. The analysis results showed that information seeking was significant in predicting analytical assessment and experiential assessment of risk information associated with COVID-19. When people feel that they have sufficient information through information seeking, they prefer to process information with a systematical way of logical reasoning, rather than simply processing in which people respond to COVID-19 without additional efforts to evaluate the information. Furthermore, the perceived threat was also crucial in predicting people's decision strategies as a psychological factor. Unlike some previous studies that only examined the impact of perceived threats on relevant analytical assessment or systematic processing in various risk situations (Hovick et al., 2011; Wei

et al., 2016), the relationships between perceived threat and these two strategies were first tested in this study. The conclusion indicated that people's threat perception was the strengthening determinant of analytical assessment. In contrast, perceived threat failed to predict the experiential assessment significantly, confirming that those who thought COVID-19 was dangerous took more effort and usually used logical evaluation and comprehensive comparison to process information regarding COVID-19.

Finally, this study focused on people's protective behaviors during the COVID-19 crisis. According to the estimated results, perceived threat and information seeking were two critical factors predicting people's protective behaviors, whose effects acted in both direct and indirect paths. To be more specific, information seeking was proved to have a significantly positive influence on people's protective behaviors, and people who obtained more information and had a high estimation level of threat of COVID-19 could be motivated to adopt protective behaviors. Meanwhile, as a psychological mechanism, information-processing strategy had a crucial mediating role in the relationship between information seeking, perceived threat, and protective behavior. On the contrary, analytical assessment and experiential assessment were both antecedents directly affecting people's protective behaviors. Concretely speaking, protective behaviors were negatively influenced by the experiential assessment, but positively influenced by analytical assessment. A possible explanation was that analytical assessment could motivate people to approach the epidemic with caution, then take positive protective actions. In contrast, the experiential assessment increased casual judgment toward COVID-19, leading to non-stressful prevention behaviors. What is more, through the mediation mechanism of information processing, people who had a high threat perception and searched for more

information could be inspired to adopt an analytical assessment to analyze existing information comprehensively and reduce intention to apply the experiential assessment, ultimately strengthening the coping behaviors for protecting themselves from the threat of COVID-19 indirectly.

Conclusion

This study systematically examines people's protective behaviors to the public health crisis of COVID-19 in China. Particular attention was given to people's perceived threats and information-processing strategies influencing their protective behaviors. We constructed a conceptual model and used structural equation modeling to explore this issue. A questionnaire survey was conducted to collect data involving 4,605 participants in the first wave of the COVID-19 outbreak in China. The results showed that people's initial information acquisition played an essential role in their behavioral responses to the crisis. Acquiring more initial information about COVID-19 would make them perceive a higher threat and present a higher demand for information, making them more likely to seek and process information and subsequently motivating their protective behaviors. In addition to increasing people's information needs, the perceived threat could also strengthen the analytical assessment and positively affect protective behavior but failed to predict the experiential assessment. Driven by information need, information seeking had a significantly positive influence on protective behavior. It also facilitated analytical assessment and decreased experiential assessment, thus predicting people's protective behaviors. Protective behaviors are spurred by analytical assessment but negatively influenced by the experiential assessment.

The main contribution of this study was enriching the current research on the issues of protective behaviors and providing new insights into the formation mechanism of protective behaviors in the public health crisis of COVID-19:

1. This study extended the application range of the protective action decision model, the heuristic-systematic information-processing model, the risk information-seeking model, and the mindsponge information-processing framework. Based on these existing theories and frameworks, we developed a new model for understanding the public's protective behaviors from the perspective of information flow, which provided empirical validations to the PADM, HSM, RISM, and MIPF.
2. This study linked perceived threat with information-processing strategies creatively and empirically tested the effects of various predictor variables on protective behaviors in detail, especially the crucial role of information-processing strategies.
3. Our survey was conducted during the first wave of the COVID-19 outbreak, and the data were representative.

This study also has some practical implications. This article enlightened us: in public health crises like COVID-19, an information promotion strategy is crucial to social risk communication and protective behavior guidance. The government should establish diversified and institutionalized information disclosure mechanisms and proactively release all kinds of information on time through various channels. For example, the government affairs hotline, government official website, WeChat, Weibo, and other new media channels should be applied flexibly to fill the gap between the sufficiency threshold of information required and the amount of currently held information for understanding risk situations. Especially, sharing scientific knowledge with people by developing more open ways of public education is needed. The discourse system should return to the scientific field to make people cautious about the risk situation and urge them to analyze the information with systematic thinking to take positive protective behaviors. At the same time, we should also recognize various reasons for improper protective behavior. However, the conditions for negative protective behavior have a common feature: The middle area of behavioral decision-making lacks factual information, knowledge information, analytical ideas, emotional feelings expression, and evaluation framework that can be used, compared, shared, and selected. Therefore, information dissemination alone cannot fundamentally eliminate the conditions for improper protective behavior. In addition to the public sector, the guidance of protective behaviors includes different unofficial social figures, such as experts, scholars, professionals, media reporters, opinion leaders, front-line staff, and self-media bloggers. These social figures can become essential supplements to the public sector in terms of behavior guidance, take on some roles that the public sector is inconvenient or unable to undertake, and play some important roles that the public sector cannot effectively play. To effectively play the vital role of social people in guiding protective behaviors, we need to provide corresponding institutional guarantee conditions. On the one hand, opinion leaders should be encouraged to guide protective behavior by providing factual information, professional knowledge, rational analysis ability, experience sharing ability, feeling expression ability, and emotional evaluation ability. Appropriate institutional space is reserved, and there is no need to demand that their expressions be the same as those of the public sector.

This article also enlightened us: in an emerging pandemic like COVID-19, until a vaccine is available, non-pharmaceutical interventions (rather than non-medical) are the primary measures to control the outbreak. To date, to control the pandemic, different countries have explored different non-drug interventions. These measures can be summarized as travel restrictions, social distancing, and personal protection measures, including canceling large mass gatherings, closing educational institutions, border restrictions, increasing personal protective equipment, conducting risk communication, strengthening public awareness and education effectiveness, providing assistance to vulnerable groups, and psychological counseling for the public.

The limitations of this study should be acknowledged. First, the study only focuses on people's protective behaviors in China, and differences may exist in different countries because of cultural differences. Future endeavors should perform some comparative studies. Second, there may be some other factors that are not being considered, such as subjective value and objective knowledge. Hence, the generalization of the results in this study may be constrained, and future studies should consider these matters. Moreover, social vaccination is a vital protective behavior against the COVID-19 (Vuong et al., 2022b), but it has been not mentioned throughout the study, because the current study's data were collected prior to the production of COVID-19 vaccines, future studies should present a careful understanding of vaccination in the context of protective behavior, especially the formation mechanism of vaccination intention should be the focus of research.

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.

Author contributions

ZP and LX were the principal investigator. CZ and ZP collected and analyzed the data under the supervision of LX. ZP and LX

designed the study and contributed to materials and analysis tools. ZP and CZ contributed to the writing of the manuscript. LX provided guidance to the 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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