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University student wellbeing during COVID-19: associations with infection prevalence and social gathering restrictions in an observational study

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Background: The COVID-19 pandemic served as a global, uncontrolled social isolation experiment, with especially pernicious effects on the wellbeing of young adults. We sought to understand how the COVID-19 pandemic impacted the wellbeing of university undergraduate students, distinguishing between factors related to infection prevalence and those linked to social restriction.

Methods: 277 total U.S. undergraduate students enrolled in a course on mental wellbeing and resilience that was offered once each year from 2020 to 2024. Students anonymously completed surveys assessing anxiety, depression, and subjective wellbeing on a weekly basis. These behavioral data were aggregated and investigated for associations with local COVID-19 case levels and a university social gathering meter.

Results: Subjective wellbeing declined a few months into the COVID-19 pandemic in Fall 2020, remaining low in Fall 2021 and Spring 2022, with 63.7% of students at-risk for poor wellbeing over these three semesters based on the standard cutoff. Depression and anxiety peaked during Fall 2021 with 39.0% and 34.5% of students at-risk for anxiety and depressive disorders, respectively. Wellbeing gradually improved following the return to in-person learning in mid-Spring 2022. Over all five semesters, survey questions reflecting anhedonia associated with social gathering restrictions whereas questions assessing acute anxiety associated with local COVID-19 case levels.

Conclusions: Our findings highlight the negative impact of the COVID-19 pandemic on university student wellbeing and suggest that COVID-19 infection prevalence and associated social isolation measures may have uniquely influenced different aspects of wellbeing. More research is needed to assess causality, while accounting for other potential socio-economic and academic factors.

KEYWORDS

COVID-19 pandemic, mental wellbeing, observational study, social isolation, undergraduate health

1 Introduction

The COVID-19 pandemic served as a global, uncontrolled social isolation experiment, with lasting consequences for physical health and psychological wellbeing. This was especially true in adolescents and young adults. A rapid systematic review published near the onset of the pandemic warned of damaging depressogenic and anxiogenic effects of social isolation and loneliness in children and adolescents, especially when prolonged (1), consistent with the effects of social isolation and loneliness on wellbeing being more debilitating in young versus older adults (2).

Undergraduate students are a particularly vulnerable population, given that many of them have left home for the first time and are therefore particularly dependent on the types of close peer contact limited by social restriction measures during COVID-19. Negative impacts of the pandemic and associated social restrictions on student wellbeing have been observed globally, including in Italy (3), France (4), China (5), and Germany, where 72.2% of undergraduate respondents endorsed serious impairments in wellbeing (6). American students similarly reported harmful effects of decreased social interactions due to physical distancing during COVID-19 closures (7). Social isolation alone likely does not account for the entire psychological burden of COVID-19. In the United States, by the third quarter of 2022, approximately two-thirds of the population had been infected with the virus (8). A large body of research demonstrates that the types of inflammatory processes engendered by the virus can cause depression (9). Completing a vicious cycle, inflammatory stimuli can also induce feelings of social isolation or disconnection (10, 11). While social distancing reduced risk of death from COVID-19, at least some of this benefit was likely counterbalanced by the fact that mortality due to loneliness and social isolation may resemble that from well-established risk factors like smoking, obesity, and hypertension (12). Given that young people were at reduced risk of COVID-19 mortality, the trade-offs between viral protection and the mental and physical health costs of isolation were likely especially unfavorable.

Along with social isolation and inflammatory processes, student wellbeing is shaped by economic and academic stressors (e.g., financial hardship, job loss, food insecurity, heavy workload) (13), family context (caregiving demands, conflict) (14), and access limitations to campus services (15); many of these risk factors were present before COVID-19 and amplified during it (16). Large multi-campus surveys and studies document these links across U.S. and international samples (17–19). In contrast, a number of protective factors can sustain wellbeing in young people, including better family functioning (20), social support/resilience (21), campus belonging (22), and healthy lifestyle factors such as physical activity (23) and sleep (24), which have each been linked to lower depression or anxiety in college cohorts during COVID-19.

Here, we sought to clarify how local COVID-19 infection prevalence and the restrictiveness of social gathering guidelines related to several aspects of university student psychological wellbeing: anxiety, depression, and subjective wellbeing. While the

metrics of wellbeing assessed in this study are foundational to both mental health and mental illness, high levels of anxiety and depressed mood and lower subjective wellbeing may be appropriate responses in the face of an international crisis, rather than indicators of pathology. The study leveraged weekly measurements across five semesters spanning the pandemic through recovery periods. Survey item-level correlations with a policy stringency index (Social Gathering Meter) and local infection data enabled high-resolution categorization of wellbeing deficits coinciding with the pandemic. Specifically, as part of a quality improvement project for our elective course titled “Mental Wellbeing and Resilience”, we obtained data on student wellbeing over three ‘COVID’ semesters (Fall [F] 2020–2021 and Spring [S] 2022) and two ‘recovery’ semesters (S23–24). Student wellbeing was measured using established scales for anxiety (7-item Generalized Anxiety Disorder Scale [GAD-7]), depression (2-Item Patient Health Questionnaire [PHQ-2]), and subjective wellbeing (World Health Organization-Five Wellbeing Index [WHO5]). Fortuitously, data collection aligned with COVID-induced social isolation and recovery measures. Masking and social distancing requirements peaked in F20 and were gradually rescinded at the university level, with a full return to largely mask-free in-person classes and social gatherings in late S22. Even as our course remained online all five semesters, the large majority of each student’s on-campus experience reflected this gradual lifting of pandemic restrictions.

2 Methods

2.1 Study overview

The study was conducted within the Center for the Study of Human Health at Emory University, Atlanta, Georgia, USA. Data that comprise the study were initially collected for course quality improvement purposes. Because of this, the study was not pre-registered. Recognizing upon completion of data collection that results were highly relevant to the impact of COVID-19 on student wellbeing, study authors petitioned the Emory University Institutional Review Board (IRB) and the study was reviewed and deemed exempt from IRB approval. 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 2013.

2.2 Participants

277 Emory University undergraduate students who enrolled in the elective course titled “Mental Wellbeing & Resilience” over five semesters from 2020 to 2024 were included in this study. Each semester corresponded to a different cohort of students, and the anonymity of responses (see below) did not allow individual students to be tracked over time; thus, this was an observational study based on successive cohorts (rather than a longitudinal design

with repeated cross-sectional measures). The course was offered once per year, in the spring (2022–24) or fall (2020–21). The breakdown of different class years (Freshmen through Seniors) for each semester and demographic information is reported in [Supplementary Table S1](#). Students were notified in class by course instructors prior to the end of the enrollment period that their enrollment in the course constituted an agreement to anonymously fill out the weekly surveys. Links to university and external mental health resources and contact information were provided on the Canvas Learning Management System and mentioned once per week in class. School credit (1 class participation point) was awarded for completion of each survey.

2.3 Anxiety, depression and wellbeing scales and percent at-risk

Students anonymously answered the clinically validated GAD-7, PHQ-2 and WHO5 each week throughout the 13–14-week course. Scale questions, answer options, and recommended cutoffs for further mental health screening are shown in [Supplementary Table S2](#). Total possible scores on the GAD-7 ranged from 0 to 21 (higher = more anxious, e.g. “Feeling nervous, anxious, or on edge”), on the PHQ-2 from 0 to 6 (higher = more depressed, e.g. “Little interest or pleasure in doing things”), and on the WHO5 from 0 to 25 (higher = greater subjective wellbeing, e.g. “I have felt cheerful and in good spirits”). Responses were submitted online through Canvas, via Likert-type scales. Individual surveys comprising the three scales were typically open for 5–7 days each week and Wednesday night (F21, S22, S24), Thursday morning (F20), or Monday night (S23). While we did not directly screen students for DSM-5 depressive or anxiety disorders, each of the scales provides recommendations on the thresholds for further clinical screening. We calculated the metric *percent at-risk* as the percentage of weekly responses that reached these criteria for each scale. While this metric reports relative severity of response, it does not necessarily predict psychopathology since recommended cutoff values were developed in normal times rather than in the context of a global pandemic.

Inter- and intra-scale reliability were assessed prior to other statistical analyses (see below). Pearson r values were tabulated to determine whether total scores were correlated between scales, and relationships between individual questions within a given scale. Weekly GAD-7 averages were significantly positively correlated with PHQ-2 averages ($r = 0.715$, $P < .0001$) and negatively correlated with WHO5 averages ($r = -0.581$, $P < .0001$), and weekly PHQ-2 averages were negatively correlated with WHO5 averages ($r = -0.746$, $P < .0001$). Within the GAD-7, correlations between individual questions ranged from 0.455 (Q1 “nervous, anxious” and Q6 “annoyed, irritable”) to 0.863 (Q1 “nervous, anxious” and Q2 “can’t stop worrying”). Within the PHQ-2, the correlation between questions Q1 (“little interest or pleasure”) and Q2 (“down, depressed, hopeless”) was 0.828. Within the WHO5, correlations ranged from 0.533 (Q2 “calm, relaxed” and Q5 “filled

with interesting things”) to 0.860 (Q2 “calm, relaxed” and Q4 “fresh, rested in AM”).

2.4 COVID-19 Cases and social gathering meter

COVID-19 county-level case numbers from DeKalb, Georgia were obtained from a publicly available New York Times/CDC database (<https://github.com/nytimes/covid-19-data>). COVID-19 case levels in university students, faculty, and staff were obtained from a publicly available dashboard with assistance from Emory’s UIT Data Solutions Service Center. All data were deidentified prior to study access and analysis. Weekly COVID-19 case numbers were calculated by summing total cases in the seven days preceding each survey deadline. For the social gathering meter, study investigators reviewed publicly available university announcements and assembled relevant guidelines into a color-coded timeline of key events reflecting tightened or loosened campus social gathering restrictions. This color coding was created by the university; study investigators assigned numeric values to each color indicating progressive increases in the severity of social restrictions, i.e. green = 1 (least restrictive), yellow = 2, modified yellow = 3, and orange = 4 (most socially restrictive). Note that this coding scheme assumes a linear gradient of restriction severity.

2.5 Data analysis

Each semester represented a unique cohort of individuals, whereas weekly scores within a semester generally included the same pool of students (with the exception of those who changed enrollment over the first few weeks of each semester or failed to submit complete surveys on a given week). Analyses were performed separately for each scale since they purport to measure different aspects of overall wellbeing and because they have different maximal scores. Nearly all study subjects provided scores at each week, leading to similar within-week variabilities, but the anonymous nature of the data precluded us from performing repeated-measures analysis on a within-subjects basis. Weekly scale scores (totals and percent at-risk) were organized by semester and averaged across weeks to derive overall mean and standard deviation values for each semester. Means were then compared using one-way ANOVA, treating semester as a fixed factor. In the case of significant results, we performed *post-hoc* testing to assess differences between semesters using Tukey’s test. To understand potential predictors of changes in wellbeing, correlation analyses with subsequent linear regression were performed for each scale with preselected variables considered to be the best representation of social isolation (university gathering meter levels) and local COVID-19 prevalence (COVID-19 case numbers in Dekalb County and university students, faculty, and staff). Correlations were performed using weekly data, rather than semesterly averages. Data are presented as mean \pm SD unless otherwise indicated, with two-tailed tests and significance set at $P \leq .05$.

3 Results

3.1 Percent at-risk for anxiety, depression, and subjective wellbeing scales over five years

We sought to understand how weekly wellness levels assessed through the three scales (GAD-7, PHQ-2, and WHO5) changed over five semesters (Figure 1). Week-by-week trajectories for scale means and percent at-risk are shown in Figure 1A. Mean scores are reported as Supplementary Results S1.

3.1.1 Overall descriptive outcomes

See Supplementary Table S1 for the mean percent at-risk each semester for each of the study's scales. For all three scales, one-way ANOVA revealed a significant effect of semester (GAD-7: $F(4, 64) = 6.8, P = .0001$; PHQ-2: $F(4, 64) = 12.0, P < .0001$; WHO5: $F(4, 64) = 13.0, P < .0001$). To further examine differences between semesters while minimizing Type I error, we applied Tukey's multiple comparisons tests for each scale (Figure 1B).

3.1.2 GAD-7

Percent at-risk for anxiety (students scoring ≥ 10 each week) was lowest in F20. The metric significantly increased in F21 (difference, -13.1; 95% CI, -20.69 to -5.43; $P < .0001$), remaining higher than F20 levels in S22 (difference, -9.8; 95% CI, -17.42 to -2.16; $P = .0054$) and S23 (difference, -8.6; 95% CI, -16.22 to -0.97; $P = .0196$) despite gradually decreasing in magnitude. By S24, percent at-risk was reduced from F21 (difference, 8.2; 95% CI, 0.72 to 15.70; $P = 0.0246$) and no different from F20 levels.

3.1.3 PHQ-2

Percent at-risk for depression (students scoring ≥ 3 each week) was greatest in F21, then dropped in S22 (difference, 7.9; 95% CI, 1.53 to 14.35; $P = .0078$). Subsequent semesters saw a further reduction, with S23 levels decreased compared to F21 (difference, 12.7; 95% CI, 6.31 to 19.13; $P < .0001$) and F20 (difference, 7.9; 95% CI, 1.34 to 14.41; $P = .0104$), and S24 levels also decreased compared to F21 (difference, 13.4; 95% CI, 7.01 to 19.83; $P < .0001$) and F20 (difference, 8.6; 95% CI, 2.05 to 15.11; $P = .0042$).

3.1.4 WHO5

Percent at-risk for low subjective wellbeing (students scoring < 13 each week) did not significantly differ between the first three semesters (F20, F21, and S22). S23 levels were lower than F20 (difference, 9.4; 95% CI, 0.17 to 18.61; $P = .0438$). During S24, percent at-risk was significantly and substantially reduced from F20 (difference, 20.3; 95% CI, 11.05 to 29.49; $P < .0001$), F21 (difference, 18.3; 95% CI, 9.28 to 27.38; $P < .0001$), S22 (difference, 17.5; 95% CI, 8.47 to 26.56; $P < .0001$), and S23 (difference, 10.9; 95% CI, 1.83 to 19.93; $P = .0107$).

3.2 Relationship between COVID-19 levels, social restriction measures, and wellbeing

We related survey results to local COVID-19 case levels and university social isolation measures. A timeline of major events associated with COVID-19, university Social Gathering Meter changes, and standardized scale scores is shown in Figure 2. Correlation analyses were run to assess relationships between exposures and wellness scales (Figure 3) or individual survey questions (Table 1) at weekly time points. Inter- and intra-scale reliability are shown in Figure 3A.

3.2.1 Correlations between scale percent at-risk and exposures

Pearson r values were tabulated to determine the relationship between weekly scale results (percent at-risk), social gathering measures, and local COVID-19 case numbers. Values are shown in Figure 3B, with highlighted correlations displayed graphically in Figure 3C. Social gathering restrictions were strongly positively correlated with percent at-risk for depression ($r = 0.47, P = 4.3E-05$) and poor subjective wellbeing ($r = 0.56, P = 4.8E-07$) but showed a trend toward negative correlation with anxiety ($r = -0.18, P = 0.14$), which was significant when Spring Break weeks were excluded ($r = -0.26, P = 0.036$). In contrast, COVID-19 case numbers at the county level were positively correlated with percent at-risk for poor subjective wellbeing ($r = 0.34, P = 0.013$). No other correlations reached significance.

3.2.2 Correlations between scale means and exposures

Pearson r values were tabulated to determine the relationship between overall and individual scale question responses (weekly means), social gathering measures, and local COVID-19 case numbers (Table 1). The strongest positive correlate of more severe social gathering meter restrictions was "little interest or pleasure" (PHQ-2 Q1) ($r = 0.47, P = 4.5E-05$) while the strongest negative correlate was "filled with interesting things" (WHO5 Q5) ($r = -0.61, P = 2.5E-08$). The strongest positive correlate of local COVID-19 cases was "nervous, anxious" (GAD-7 Q1) (Emory students, faculty, and staff: $r = 0.37, P = 0.0059$; Dekalb County: $r = 0.40, P = 0.0029$) while the strongest negative correlate was "calm, relaxed" (WHO5 Q2) (Emory students, faculty, and staff: $r = -0.37, P = 0.0055$; Dekalb County: $r = -0.44, P = 0.00099$).

4 Discussion

4.1 Wellbeing across semesters

The COVID-19 pandemic coincided with a wellbeing crisis that plagued college campuses nationwide (25–27). To distinguish between factors related to infection prevalence and those tied to

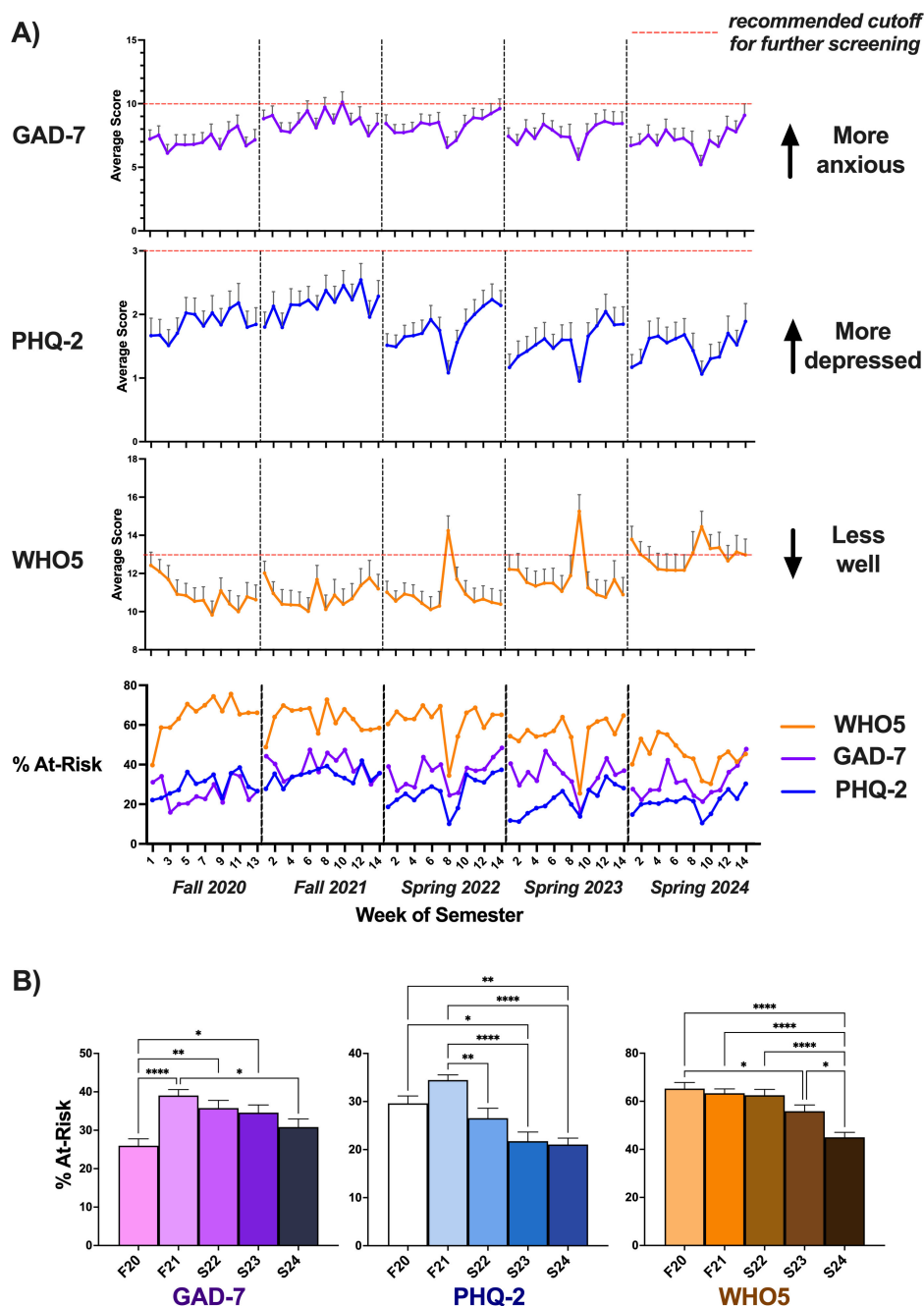
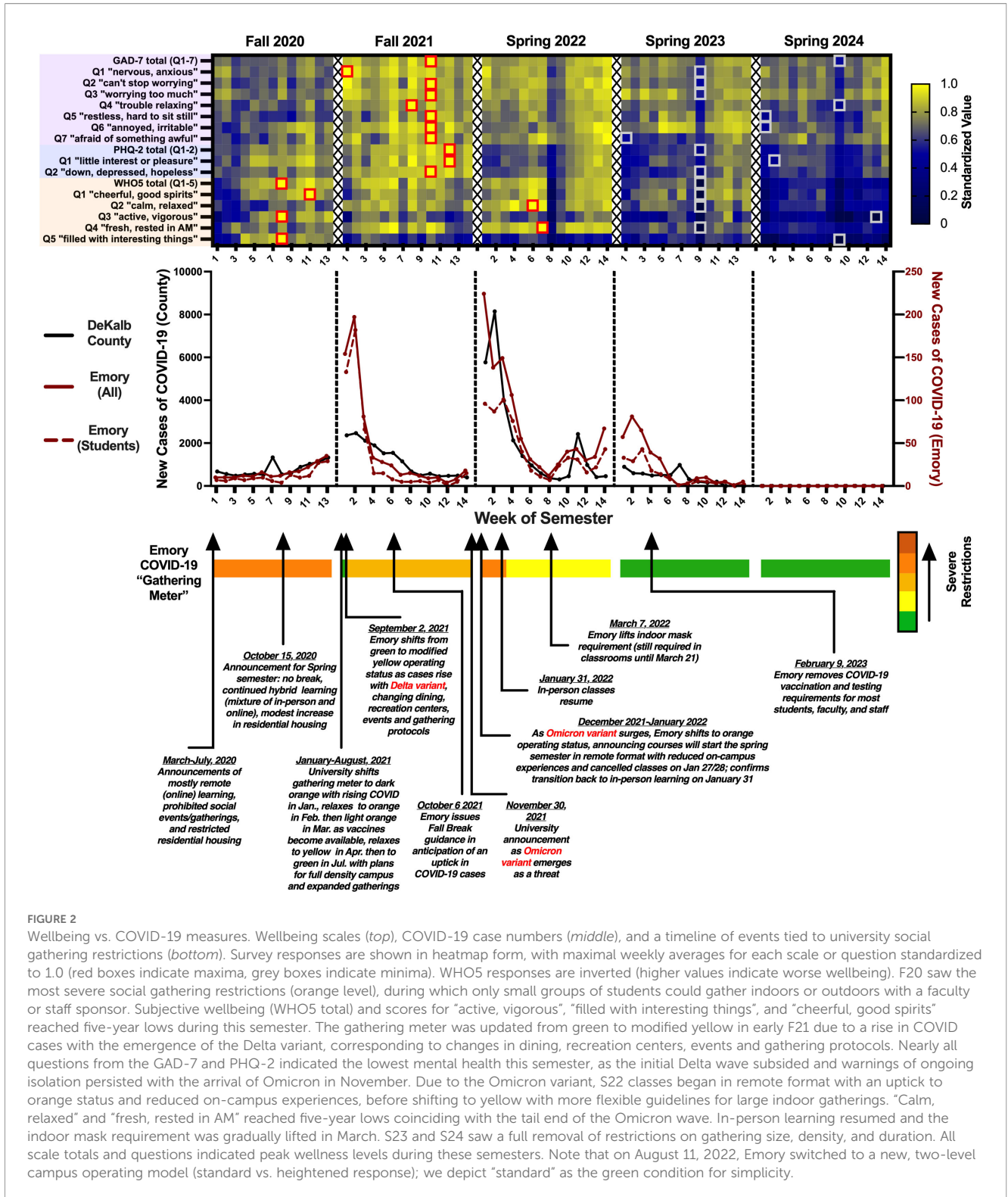


FIGURE 1

Wellbeing across semesters. (A) Wellness scale mean scores and percent at-risk over five semesters. Top three panels: Average weekly scores are shown for the individual scales, with error bars indicating variability between students at each time point (~47–69 students were averaged for each data point, depending on the semester; see Supplementary Table S1). Bottom panel: For percent at-risk, an aggregate value was obtained at each time point (number of students “at-risk” divided by total students, multiplied by 100). Acute increases in wellbeing were observed around the mid-point of each semester corresponding to the Spring or Fall Break periods. (B) Semester averages for percent at-risk, shown for each of the wellness scales. Supporting the trends visible in (A), percent at-risk on the GAD-7 and PHQ-2 peaked in F21. WHO5 percent at-risk values remained relatively stagnant before declining in S23 and falling precipitously in S24. * $P < .05$, ** $P < .01$, *** $P < .0001$.

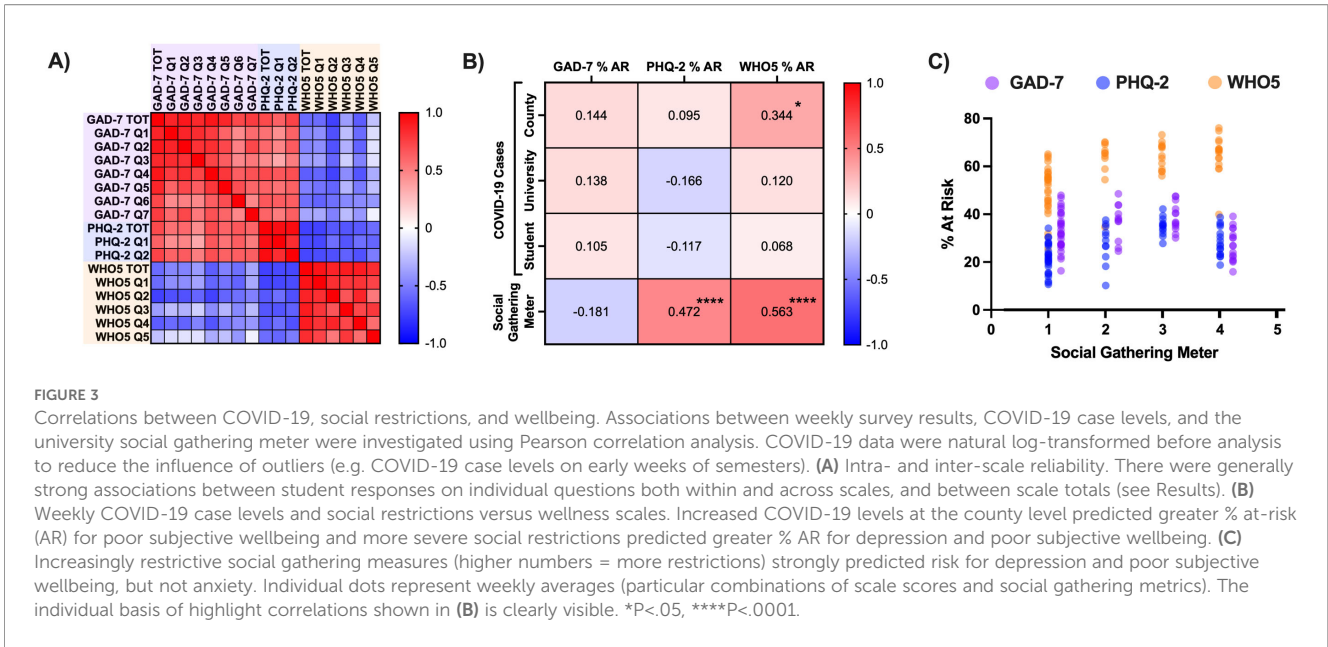
social restrictions, we collected data on student wellbeing, local COVID-19 case numbers, and social isolation measures at weekly time points from 277 university students over five semesters from 2020–2024. Survey responses indicated increased depression and anxiety and reduced subjective wellbeing in the midst of the COVID-19 pandemic (2020–2022), with an improvement in these

metrics as concerns about infection waned and social restrictions were terminated during the 2023–2024 semesters. The most severe social isolation measures, implemented in F20, preceded a precipitous decline in student wellbeing (Figures 1, 2). Anxiety (measured via the GAD-7) and depression (measured via the PHQ-2) spiked in F21 as the Delta variant of COVID-19 caused



prolonged disruptions. Amidst the ongoing uncertainty sandwiched between the Delta and Omicron variants (with Omicron emerging in late November 2021), responses to nearly all of the GAD-7 and PHQ-2 questions reached their peaks. Subjective wellbeing

(measured via the WHO5), in contrast, declined quickly the first few weeks of F20 and languished at a trough from F20 through S22, with a high percentage of students considered at-risk for poor wellbeing during all three semesters. At the tail-end of the Omicron



wave in mid-S22, immediately preceding the university’s removal of mask restrictions, students rated themselves the least fresh, rested, and relaxed of any point over the five years, possibly reflecting sleep difficulties (3) or a state of burnout (28) associated with the toll of an extended period of chronic unpredictable stress. Despite a return to a more normalized social environment, subjective wellbeing scores lagged behind, trending upward only in S23 and peaking in S24.

4.2 Associations between COVID-19 prevalence, social isolation, and wellbeing

To better understand pandemic-related factors that might predict specific deficits in wellbeing, we evaluated the separate associations of social restrictions and infection prevalence with PHQ-2, GAD-7 and WHO5 scores at weekly time points. Positive associations were observed between severity of university social

TABLE 1 Rank-ordered correlations between wellness scale questions, COVID-19 cases, and social gathering restrictions^a.

Social gathering meter		Emory COVID-19 cases		County COVID-19 cases	
Scale total or subquestion	Pearson r	Scale total or subquestion	Pearson r	Scale total or subquestion	Pearson r
PHQ-2 Q1 “little interest or pleasure”	0.470	GAD-7 Q1 “nervous, anxious”	0.367	GAD-7 Q1 “nervous, anxious”	0.405
PHQ-2 total (Q1-2)	0.466	GAD-7 Q2 “can’t stop worrying”	0.276	GAD-7 Q3 “worrying too much”	0.288
PHQ-2 Q2 “down, depressed, hopeless”	0.433	GAD-7 Q3 “worrying too much”	0.270	GAD-7 Q4 “trouble relaxing”	0.234
GAD-7 Q4 “trouble relaxing”	0.134	GAD-7 Q4 “trouble relaxing”	0.159	GAD-7 Q2 “can’t stop worrying”	0.233
GAD-7 Q1 “nervous, anxious”	0.095	GAD-7 total (Q1-7)	0.146	GAD-7 total (Q1-7)	0.217
GAD-7 Q7 “afraid of something awful”	0.084	WHO5 Q5 “filled with interesting things”	0.145	GAD-7 Q7 “afraid of something awful”	0.172
GAD-7 Q6 “annoyed, irritable”	0.039	GAD-7 Q7 “afraid of something awful”	0.111	PHQ-2 Q2 “down, depressed, hopeless”	0.130
GAD-7 total (Q1-7)	0.030	WHO5 Q1 “cheerful, good spirits”	-0.056	PHQ-2 total (Q1-2)	0.063
GAD-7 Q2 “can’t stop worrying”	-0.014	PHQ-2 Q2 “down, depressed, hopeless”	-0.062	GAD-7 Q5 “restless, hard to sit still”	-0.015
GAD-7 Q5 “restless, hard to sit still”	-0.049	WHO5 Q3 “active, vigorous”	-0.082	PHQ-2 Q1 “little interest or pleasure”	-0.021
GAD-7 Q3 “worrying too much”	-0.082	PHQ-2 total (Q1-2)	-0.125	GAD-7 Q6 “annoyed, irritable”	-0.069

(Continued)

TABLE 1 Continued

Social gathering meter		Emory COVID-19 cases		County COVID-19 cases	
Scale total or subquestion	Pearson r	Scale total or subquestion	Pearson r	Scale total or subquestion	Pearson r
WHO5 Q2 “calm, relaxed”	-0.287	GAD-7 Q5 “restless, hard to sit still”	-0.146	WHO5 Q5 “filled with interesting things”	-0.106
WHO5 Q1 “cheerful, good spirits”	-0.383	WHO5 total (Q1-5)	-0.167	WHO5 Q1 “cheerful, good spirits”	-0.243
WHO5 Q4 “fresh, rested in AM”	-0.412	PHQ-2 Q1 “little interest or pleasure”	-0.182	WHO5 Q3 “active, vigorous”	-0.308
WHO5 total (Q1-5)	-0.536	GAD-7 Q6 “annoyed, irritable”	-0.251	WHO5 total (Q1-5)	-0.360
WHO5 Q3 “active, vigorous”	-0.603	WHO5 Q4 “fresh, rested in AM”	-0.315	WHO5 Q4 “fresh, rested in AM”	-0.402
WHO5 Q5 “filled with interesting things”	-0.611	WHO5 Q2 “calm, relaxed”	-0.369	WHO5 Q2 “calm, relaxed”	-0.444

^aSignificant Pearson r values are shown in bold. For the university Social Gathering Meter, green status was coded as “1” (least restrictive), yellow as “2”, modified yellow as “3”, and orange as “4” (most socially restrictive). COVID-19 cases were natural log transformed to deal with outliers.

gathering restrictions and risk for both depression and reduced subjective wellbeing, but not anxiety (Figure 3). Analyses of individual items confirmed that every item from the PHQ-2 and WHO5 scales was significantly correlated with social gathering meter levels, whereas none of the anxiety items were (Table 1). In contrast, item analysis revealed that increased infection prevalence was associated with heightened anxiety and reduced subjective wellbeing, but not with increases in depression. There were especially robust associations between COVID-19 infection rates and anxiety, and social restriction measures and increases in items related to anhedonia (PHQ-2 Q1, “Little interest or pleasure in doing things”; and WHO5 Q5, “My daily life has been filled with things that interest me”). Since the highest COVID-19 values were almost always observed near the start of a semester (Figure 2), when students typically report greater wellbeing, the strength of our observed correlations may have been reduced. It is important to note that observed correlations do not establish causality. It is possible that other explanatory variables contributed to our findings. For example, sleep loss or temporary reductions in counseling/service access may have elevated anxiety or depressive symptoms independent of gathering restrictions or case numbers. Furthermore, while correlations were performed using weekly (rather than semesterly) data to increase resolution, the successive-cohort design prevented tracking changes at the individual level. Nonetheless, these findings provide information that will be important for considering how to best manage the implications of future pandemics for college student wellbeing. While social restrictions are an important tool for disease containment and were implemented with a clear public health rationale during COVID-19, identifying and implementing strategies for reducing the hedonic costs of these measures will be essential.

4.3 Study limitations

The current study has several important limitations. Students self-selected to enroll in our university course. Students already facing or more prone to develop mental health challenges may be more likely to enroll in a course on mental wellbeing and resilience, introducing a potential selection bias. While we did not assess student interest in course topics or mental health histories, our student sample (Supplementary Table S1) was broadly representative of the overall Emory College student population from a demographic standpoint (with 22.9% of students self-identifying as Asian, 8.1% as Black or African American, 11.1% as Hispanic/Latino, 34.5% as White, and 17.7% as International, with 57.9% female, as of 2021 (29)). Furthermore, the GAD-7, PHQ-2, and WHO5 were designed for measuring generalized anxiety disorder (30), depression (31, 32), and subjective wellbeing (33), respectively, in the general population rather than specifically targeting young adults or university students. Nonetheless, percent at-risk levels were similar to those observed in other student cohorts (6). Because two of our cohorts filled out the surveys in the fall (F20/F21) and three in the spring (S22-24), changes in wellbeing due to seasonal effects or the structure of an academic year (which typically runs from late August to the following May) may pose a potential confound for the interpretation of our findings. For example, students taking the class in the spring may anticipate the upcoming summer break with enthusiasm. Alternatively, seasonal depression often occurs in the late fall or early winter, possibly leading to lower fall semester wellness scores. While this confound cannot be entirely ruled out, S22 was one of the worst two semesters for student wellbeing despite an emerging return to normalcy. If seasonal effects were important, one might also predict differential trajectories in wellbeing over the course of a fall and spring semester, i.e. gradual deterioration in the fall and a

rise in the spring. However, this was not the case (see Figure 1), as across all cohorts wellbeing declined from the start to the end of each semester. Finally, our study provides exploratory value by highlighting descriptive associations between psychological wellbeing, infection prevalence, and social restrictions. Further investigation is needed using a true longitudinal study design to adequately test the hypothesis that infection prevalence and social isolation are selective drivers of anxiety and anhedonia, respectively.

4.4 Conclusions

The COVID-19 pandemic took a heavy toll on the mental wellbeing of our university undergraduates, with signs of anxiety as local COVID-19 prevalence skyrocketed and signs of anhedonia as social gatherings were restricted. Despite the impact of the pandemic on student anxiety and depression levels, their relatively quick recovery (by S22-S23) suggests that COVID-19 may not have had lasting detrimental effects on these outcomes. Subjective wellbeing followed a similar pattern but was slower to return to normal. These findings broadly agree with those from a recent longitudinal study (34), together suggesting that students were more quickly able to resolve acute distress, whereas the full return to a state of happiness or life satisfaction required more time. Nevertheless, many students remained at-risk for depression or anxiety at the end of the study (Figure 1) based on scale guidelines. Our results fit within a broader scientific debate on student wellbeing during COVID-19. While infection-associated policy stringency has previously been linked to poorer wellbeing (35), many additional or co-related factors play a role – often with small, heterogenous, and context-dependent effects (36). Risk and protective factors include food insecurity or financial strain (37, 38), academic stressors (39, 40), social media usage (41, 42), family functioning (14, 20), perceived social support/resilience (21, 43), regular physical activity (23, 44, 45), and adequate sleep (24). By relating weekly, item-level student wellbeing data to campus-specific policy stringency and local infection metrics across five semesters spanning the pandemic through recovery period, our study adds insight to this body of literature. Future studies should (1) measure time-varying covariates of infection prevalence and social isolation; and (2) leverage within-person longitudinal designs to assess causality. These steps will help clarify for whom, when, and which factors matter most for student wellbeing during and beyond public health disruptions. Even with the pandemic waning, Americans increasingly spend time alone (46). Clearly, student wellbeing remains a pressing cause for concern and there is ample room for novel interventional and educational research. For example, young adults spend more time scrolling through short-form videos than ever before, and this appears to correspond to deficits in cognitive function and wellbeing (47). Future research should investigate whether the wellbeing deficits we observed in association with enforced isolation are replicated in similar non-pandemic contexts by tracking device usage in combination with metrics to assess both the *quantity* and *quality* of social interactions (e.g. using ecological momentary assessment).

A related question is whether voluntary substitution of in-person interaction with social media usage produces deficits similar to those observed here. Answering such questions will be an important step toward deciphering the active ingredients of mental wellbeing in an increasingly interconnected world.

Data availability statement

The datasets presented in this article are not readily available because student datasets cannot be shared for legal, ethical, or privacy reasons. Requests to access the datasets should be directed to Donald Noble, djnoble@emory.edu.

Ethics statement

The studies involving humans were approved by Emory University Institutional Review Board (IRB). The studies were conducted in accordance with the local legislation and institutional requirements. The ethics committee/institutional review board waived the requirement of written informed consent for participation from the participants or the participants' legal guardians/next of kin because the study was determined to be exempt from further IRB approval, and analyzed data that was previously collected for a quality improvement project.

Author contributions

DN: Conceptualization, Validation, Methodology, Formal Analysis, Writing – review & editing, Writing – original draft, Investigation. CR: Writing – review & editing, Methodology, Conceptualization, Investigation.

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Conflict of interest

CR serves as a consultant to Usona Institute, Otsuka, AbbVie and Eli Lilly and receives grant support from the Tiny Blue Dot Foundation.

The remaining author declared that this work 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/fpsy.2025.1641305/full#supplementary-material>

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