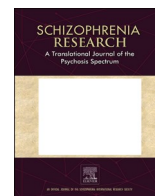




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COVID-19 dimensions and psychotic experiences among US college students: Findings from the Healthy Mind Study 2020

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ABSTRACT

Background: The COVID-19 pandemic has caused tremendous changes in daily living, which may be related to mental health problems, including psychotic experiences, though research has only begun to assess these associations.

Methods: We analyzed data from the Healthy Minds Survey (Fall Semester Cohort 2020), which is a non-probability sample of students attending one of 36 universities in the United States, who completed an online survey during the COVID-19 pandemic (September–December 2020). We used multivariable logistic regression to examine the associations between several COVID-19 dimensions (anxiety, discrimination, financial distress, infection, illness of loved one, death of loved one, caregiving) and 12-month psychotic experiences, adjusting for age, gender, race/ethnicity, and international student status.

Results: Each individual COVID-19 dimension was significantly associated with greater odds of having 12-month psychotic experiences, with the exception of being a caregiver. When accounting for all COVID-19 dimensions simultaneously in the same model, only COVID-19 related anxiety, financial distress, and infection were associated with psychotic experiences.

Conclusion: COVID-19 dimensions were linked to psychotic experiences among university students, which may also apply to the larger population. This can potentially inform assessment and treatment during the pandemic.

1. Introduction

As of March 2021, the COVID-19 pandemic resulted in a total of over 28,500,000 infections in the United States, with a death toll of over half a million (Centers for Disease Control and Prevention, 2021). The pandemic dramatically altered the country's way of life, which may be linked to elevated levels of mental health problems in the population (Rajkumar, 2020; Luo et al., 2020; Xiong et al., 2020; Hossain et al., 2020; Vindegaard and Benros, 2020). Between 2019 and 2021, the overall prevalence of depression and anxiety symptoms increased in the country (Panchal et al., 2020), along with other mental health problems, substance use, and suicidal thoughts and behaviors (Rosenberg et al., 2021; Khubchandani et al., 2020; Ammerman et al., 2021). COVID-19 infection may have had direct health effects that include cognitive problems and psychiatric symptoms during and even after recovery from

the virus (Whiteside et al., 2021). However, those who were not infected may still have suffered mental health problems from encountering several COVID-19 related stressors, including job loss and financial distress (Bureau of Labor Statistics, 2020; Panchal et al., 2020), the rise in racist and xenophobic discrimination (Dhanani and Franz, 2020), isolation due to lockdowns and social distancing (Rosenberg et al., 2021), and worrying about loved ones being infected (Deng et al., 2020; Gallagher et al., 2020).

Several clinical reports and preliminary epidemiological research showed that COVID-19 infection has been associated with psychotic symptoms (Lanier et al., 2020; Huarcaya-Victoria et al., 2020; Rentero et al., 2020; Oh et al., 2021). The pandemic has also appeared to have given rise to unusual beliefs regarding the origins of COVID-19, sometimes referred to as “conspiracy theories,” which have been identified as a potential coping mechanism (Fountoulakis et al., 2020). It has been

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hypothesized that such beliefs may lie on the psychosis continuum, and may be rooted in similar errors in cognitive processes (Freeman, 2007; Sanchez and Dunning, 2020). However, there have been few large-scale studies to examine the wide range of COVID-19 dimensions and their effects on psychotic experiences. As such, in this study we examined the associations between several COVID-19 dimensions and their associations with 12-month psychotic experiences among university students in the United States.

2. Methods

2.1. Sample

We analyzed data from the Fall semester cohort of the 2020 Healthy Minds Study (HMS), a cross-sectional, web-based survey examining mental health and related factors in undergraduate and graduate student populations. The survey was administered at 36 universities between September through December of 2020. At each university, a random sample of 8000 students was invited by e-mail to participate, except at smaller universities (<8000 students) where all students were invited to participate. The response rate was 14%, which is typical of online surveys of university populations. The HMS was approved by the Institutional Review Boards at all participating campuses.

2.2. Measures

2.2.1. COVID-19 dimensions (independent variables)

We examined seven COVID-19 dimensions.

Anxiety was measured using nine items that asked: “Over the past two weeks, on average, how much have you been concerned with the following?” The nine items are listed in Table S1. Respondents could answer: Not concerned at all, slightly concerned, moderately concerned, very concerned, and extremely concerned. The nine items were summed into a scale between 10 and 50 ($\alpha = 0.92$).

Racial/ethnic discrimination was measured using the binary item (yes/no): “As a result of the COVID-19 pandemic, have you experienced any discriminatory or hostile behavior due to your race/ethnicity (or what someone thought was your race/ethnicity)?”

Financial distress was measured using the item: “How has your financial situation been affected by the COVID-19 pandemic?” Respondents would answer: a lot less stressful, somewhat less stressful, no significant change, somewhat more stressful, a lot more stressful.

Infection was measured using the item: “Have you had COVID-19 (the novel coronavirus -disease)?” Responses included: yes (confirmed by a test); probably (e.g., a healthcare provider told me that I likely had COVID-19); maybe (e.g., I have had symptoms consistent with COVID-19, but it was not confirmed by a test); and no (no symptoms or other reason to think I have had it). The responses ‘yes’, ‘probably’, and ‘maybe’ were combined to form a binary variable indicating likely COVID-19 infection.

Illness of loved one was assessed using the single binary item (yes/no): “Has a loved one, close family member, or friend experienced significant illness as a result of COVID-19?”

Death of loved one was assessed using the single binary item (yes/no): “Have you grieved the loss of a loved one, close family member, or friend due to COVID-19?”

Caregiver was measured using the single binary item (yes/no): “Have you been a caregiver to someone who experienced illness as a result of COVID-19?”

2.2.2. Psychotic experiences

Psychotic experiences were measured using an abbreviated version of the World Health Organization Composite International Diagnostic Interview Psychosis Screen, which has been used in large global epidemiology studies (McGrath et al., 2016). Respondents were asked if they had ever experienced the following at any point in life: (1) A feeling

something strange and unexplainable was going on that other people would find hard to believe; (2) A feeling that people were too interested in you or that there was a plot to harm you?; (3) A feeling that your thoughts were being directly interfered or controlled by another person, or your mind was being taken over by strange forces?; and (4) An experience of seeing visions or hearing voices that others could not see or hear when you were not half asleep, dreaming, or under the influence of alcohol or drugs? Endorsing any of these experiences constituted lifetime psychotic experience. Respondents were then asked a single item (yes/no) about whether these experiences occurred over the past 12 months.

2.2.3. Sociodemographic covariates

Respondents self-reported sociodemographic characteristics, including gender (man, woman, and non-binary), race/ethnicity (white, Black, Asian Pacific Islander, Hispanic, multi-racial), age (continuous), and international student status (yes/no).

2.3. Analysis

Out of 36 colleges, 28 colleges administered the COVID-19 module ($N = 15,995$). We used complete case analysis to address missing data. We used multivariable logistic regression analyses to test for associations between COVID-19 dimensions and 12-month psychotic experiences, adjusting for age, gender identity, race/ethnicity, and international student status. First, we examined each of the nine COVID-19 dimensions in separate fully adjusted models, and then simultaneously adjusted for all nine COVID-19 dimensions in the same model. We applied sample probability weights to adjust for non-response using the administrative data on full student populations with respect to gender, race/ethnicity, academic level, and GPA. We clustered standard errors by university, and presented results as odds ratios with 95% confidence intervals.

3. Results

Descriptive characteristics are presented in Table 1. In these data, approximately 14-15% of the sample reported having a psychotic experience over the past year. We calculated means and proportions of COVID-19 dimensions among those with and without psychotic experiences. Overall, the means and proportions of COVID-19 factors were higher among those with psychotic experiences, however, not always to a statistically significant degree. Bivariate logistic regression models are available in the Supplemental Materials (Table S2).

Each individual COVID-19 dimension was associated with greater odds of having 12-month psychotic experiences. However, not all COVID-19 dimensions (e.g., being a caregiver) reached a conventional level of statistical significance. When accounting for all COVID-19 dimensions in the same model, only anxiety, financial distress, and infection were significantly associated with psychotic experiences. See Table 2.

4. Discussion

Our findings showed that COVID-19 dimensions were related to 12-month psychotic experiences in a large non-probability sample of college students in the United States during the pandemic, though the strength and significance of the associations varied. In separate models, all the COVID-19 dimensions were significantly associated with psychotic experiences, except for being a caregiver for someone who became ill due to COVID-19. While caretaker burden is a significant source of stress in other contexts (Adelman et al., 2014), it did not appear to increase odds of reporting psychotic experiences at a conventional level of statistical significance in these data, possibly because caregiving may even increase social contact with others. The COVID-19 anxiety scale captured several distressing aspects of the pandemic (e.g.,

Table 1
Descriptive statistics.

Variables	No psychotic experiences (n = 13,720)	Psychotic experiences (n = 2215)	Total (N = 15,935)	P-value
COVID-19 dimensions				
Anxiety (10-50)	31.90 (30.84 - 32.97)	34.07 (32.92 - 35.23)	32.22 (31.22 - 33.22)	0.07
Racial/ethnic discrimination				
No	12,830 (94.96%)	2001 (92.26%)	14,831 (94.57%)	<0.01
Yes	730 (5.04%)	185 (7.74%)	915 (5.43%)	
Financial stress (0-4)	2.82 (2.77-2.87)	3.01 (2.96-3.06)	2.85 (2.80-2.89)	0.01
Infection				
No	10,852 (78.81%)	1633 (72.98%)	12,485 (77.97%)	<0.01
Yes	2868 (21.19%)	582 (27.02%)	3450 (22.03%)	
Illness of loved one				
No	9518 (67.86%)	1397 (61.89%)	10,915 (67.00%)	<0.01
Yes	4231 (32.14%)	817 (38.11%)	5048 (33.00%)	
Death of a loved one				
No	12,707 (91.45%)	2002 (88.13%)	14,709 (90.97%)	0.01
Yes	1021 (8.55%)	211 (11.87%)	1232 (9.03%)	
Caregiver				
No	12,914 (93.50%)	2067 (92.23%)	14,981 (93.31%)	0.25
Yes	823 (6.50%)	146 (7.77%)	969 (6.69%)	
Sociodemographic characteristics				
Age	24.51 (23.53 - 25.49)	23.21 (22.26 - 24.16)	24.32 (23.37 - 25.27)	0.07
Race/ethnicity				
White	16,617 (63.83%)	2618 (62.76%)	19,235 (63.68%)	<0.01
Asian Pacific Islander	3226 (8.05%)	416 (7.71%)	3642 (8.00%)	
Black	1582 (7.90%)	286 (5.82%)	1868 (7.60%)	
Latinx	2034 (9.17%)	341 (8.40%)	2375 (9.06%)	
Multiracial	2386 (9.52%)	529 (13.54%)	2915 (10.11%)	
Other	363 (1.02%)	60 (1.13%)	423 (1.04%)	
Missing/unknown	103 (0.50%)	21 (0.63%)	124 (0.52%)	
Gender				
Man	7473 (41.42%)	1306 (44.55%)	8779 (41.88%)	<0.01
Woman	18,271 (56.49%)	2717 (49.53%)	20,988 (55.47%)	
Non-binary	520 (1.93%)	234 (5.66%)	754 (2.47%)	
Missing/unknown	47 (0.16%)	14 (0.26%)	61 (0.18%)	
Are you an international student?				
No	24,699 (96.02%)	4052 (96.43%)	28,751 (96.08%)	0.50
Yes	1605 (3.98%)	218 (3.57%)	1823 (3.92%)	

P-values by t-test for continuous variables and Chi2 test for binary/categorical variables.

fear of contracting the virus, feelings of isolation), which were associated with greater odds of psychotic experiences, corroborating early clinical reports (Huarcaya-Victoria et al., 2020; Rentero et al., 2020). These anxieties may have also reflected greater social isolation, which

Table 2
Multivariable logistic regression models depicting associations between COVID-19 dimensions and 12-month psychotic experiences.

	Separate models with predictors individually associated with outcome			All predictors adjusted for in same model		
	aOR	p-Value	N	aOR	p-Value	N
Anxiety (10-50)	1.02 [1.01, 1.04]	0.000	14,725	1.02 [1.01, 1.03]	0.004	14,646
Racial/ethnic discrimination	1.70 [1.16, 2.51]	0.009	15,741	1.45 [0.91, 2.31]	0.118	
Financial distress (0-4)	1.31 [1.22, 1.41]	0.000	30,531	1.18 [1.05, 1.34]	0.010	
Infection	1.36 [1.13, 1.64]	0.002	15,930	1.35 [1.08, 1.69]	0.011	
Illness of loved one	1.34 [1.18, 1.53]	0.000	15,958	1.10 [1.01, 1.21]	0.037	
Death of a loved one	1.59 [1.24, 2.03]	0.001	15,936	1.31 [1.00, 1.71]	0.049	
Caregiver	1.29 [0.94, 1.77]	0.117	15,945	1.17 [0.78, 1.75]	0.448	

Adjusted for age, gender, race/ethnicity, and international student status. Healthy Minds Study, September–December 2020.

has been known to increase risk for psychotic experiences (e.g., Lim and Gleeson, 2014; Dodell-Feder et al., 2020). Discrimination has been strongly linked to psychotic experiences in prior studies (Bardol et al., 2020; Pearce et al., 2019), and our findings align with the social defeat model, where experiences of exclusion from the social majority group can result in an elevated risk of psychosis in vulnerable individuals (Selten and Cantor-Graae, 2005; Selten et al., 2013). Financial distress due to COVID-19 comports with the literature that suggests socioeconomic status and social disadvantage are related to psychosis (Oh et al., 2021; Morgan et al., 2009); however, the entire sample consisted of college students, which represents a particular social strata of educated individuals. That being said, there is considerable heterogeneity within the college population, and experiencing financial stress while being a student may signify more precarious life circumstances and vulnerability to mental health problems. COVID-19 infection was associated with psychotic experiences, and it is possible that the virus may cause a profound inflammatory response that results in hallucinations or delusions. Having loved ones contract the virus or die from it can be major life stressors that are linked to psychotic experiences, which also comports with prior studies (Castelnovo et al., 2015).

The COVID-19 pandemic constituted a major stressful life event that proliferated stress and may have been linked to both the onset and re-emergence of psychosis (Martland et al., 2020). While the exact pathways are unclear, it is possible that COVID-19 operates through psychological mechanisms such as dissociation, emotional dysregulation, negative mood states, and increased vigilance (Alameda et al., 2020). The biological correlates may possibly include altered neuroimmune signaling (Fillman et al., 2014), increased activity in monoamine circuits mediating arousal (Ross and Van Bockstaele, 2021), dysregulation of dopaminergic circuits connecting the midbrain to cortical and limbic regions (Sonnenschein et al., 2020) and genetic variants affecting neuropeptide and neuroendocrine reactivity to stress (Cristóbal-Narváez et al., 2017). COVID-19 infection may itself be associated with a risk of psychosis (Oh et al., 2021), but the analysis of this association is confounded by several factors (Watson et al., 2020). However, the multitude of stressors related to the pandemic and its attendant control measures—particularly social-evaluative stressors that lead to social

defeat—have been linked to psychosis risk via the mechanisms listed above, as well as through dysregulation of the hypothalamic-pituitary-adrenal axis (Carol et al., 2021; Murray et al., 2020). This may be reflected in our associations of discrimination, financial stress (which may cause a respondent to lose social status), and COVID-19 anxiety (which may cause an individual to withdraw socially during the pandemic), but not for caregiving (which is a stressful experience that increases engagement with other people while imparting feelings of self-worth).

4.1. Limitations

Our study is among the first large-scale studies to examine COVID-19 factors and psychotic experiences among college students in the US; however, there were several limitations. First, data were cross-sectional and did not allow for us to ascertain the temporal order of events or make causal inferences, though it is unclear how psychotic experiences would directly cause these COVID-19 dimensions. With that said, it is possible that individuals with paranoid ideation may be more likely to experience COVID-19 anxiety or perceive COVID-19 related racial discrimination. Second, the data were self-reported, and may have been vulnerable to recall and social desirability biases (e.g., reluctance to disclose the occurrence of psychotic experience or COVID-19 infection). Third, this study was only conducted among college students, most of whom were in the peak age range for psychosis risk; however, more research is needed to determine whether these findings are generalizable to the larger population. Our findings may also contradict findings from other countries (Bortolon et al., 2021), and should be properly contextualized. Fourth, the response rate was 14%, which raises concerns about sampling bias and generalizability of findings, though this response rate is comparable to surveys of this nature, and survey weights were used to adjust for non-response.

4.2. Conclusion

This study shows that the effects of the COVID-19 pandemic created conditions that are linked to the occurrence of psychotic experiences during roughly the same time period of the pandemic. While the sample in this study consisted of college students, they are generally within the age range when psychotic experiences often first occur (McGrath et al., 2016). Our findings may inform preventive interventions during the pandemic, given that psychotic experiences are linked to a wide range of mental and physical health problems and may be indicative of underlying (psycho)pathology (Oh et al., 2021). To reduce risk for psychosis and other mental health problems, it may be critical to formulate broad efforts to address the range of stressors related to COVID-19 (e.g., financial stress, loneliness, grief/bereavement), potentially through telehealth.

Contributors

Dr. Hans Oh was the primary author and performed all statistical analyses. Ms. Jessica Goehring ran statistical models and provided editorial assistance. Dr. Ravi Rajkumar provided conceptual support and contributed to the writing of the manuscript. Ms. Megan Besecker provided statistical consultation. Dr. Jordan DeVlyder provided conceptual assistance and contributed to the writing of the manuscript.

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None.

Declaration of competing interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.schres.2021.09.003>.

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