



An Observational Study to Assess the Impact of COVID-19 on the Factors Affecting the Mental Well-being of Doctoral Students

Sreejata Dutta¹ · Arundhati Roy² · Soham Ghosh³

Accepted: 24 June 2022

© Associação Brasileira de Psicologia 2022

Abstract

The effects of SARS-CoV-2 on mental health far extend its effects on physical well-being. Long before the onset of COVID-19, there have been concerns related to the mental well-being of graduate students, especially doctoral students. This study evaluated the factors associated with the mental well-being of doctoral students since the onset of the pandemic using data collected from early career researchers in the UK in April 2020. The results show that the characteristics of mental well-being associated with social connection, loneliness, and anxiety have remained consistent during the lockdowns. Furthermore, everyday stressors related to lifestyle, finances, and caregiving responsibilities, alongside supervisors and university support, influenced the mental well-being of the doctoral students during the pandemic.

Keywords Mental well-being · Doctoral students · Impact of COVID-19 · Psychological scales · Mental health

✉ Sreejata Dutta
sdutta3@kumc.edu

Arundhati Roy
rarundhati111@gmail.com

Soham Ghosh
sghosh27@ku.edu

¹ Department of Biostatistics & Data Science, University of Kansas Medical Center, Kansas City 66160, KS, USA

² IBM, Bengaluru, India

³ School of Engineering, University of Kansas, Overland Park, USA

Introduction

The COVID-19 pandemic has changed the world in many ways. According to the statements released by the World Health Organization (WHO), COVID-19 “presents an unprecedented challenge to public health, food systems, and the world of work.” The pandemic has ravaged the globe claiming millions of lives while disrupting the physical and psychological well-being of numerous across different multitude (Phillips, 2021). Fears of uncertainty related to the unknown, loss of employment, food disruption, lack of healthcare resources, and social isolation continue to impose threats on the psychological well-being of the population. Furthermore, researchers around the world have speculated that the many effects of COVID-19 are about to linger for a much-extended period (Lavine et al., 2021).

Previous research has confirmed the detrimental effects of COVID-19 on marginalized populations, based on race, age, gender, unemployment, and occupation (Alon et al., 2020; Bernstein & Jones, 2020; CDC, 2021; Chapman, 2020; Gould et al. 2020; Venkatesh, 2020). Reports from the Bureau of Labor Statistics indicated that nearly 15% of adults faced unemployment during the pandemic. Cases of violence and abuse against women and children have been on the rise since the onset of lockdown (Petrowski et al., 2021). In addition, one in every four women was affected by an increase in household responsibilities during the lockdowns (Bateman & Ross, 2020). According to the Centers for Disease Control and Prevention (CDC), ethnic and racial minority groups had a higher prevalence of certain mental illnesses, substance abuse, and lack of health care during the pandemic (McKnight-Eily et al., 2021; Tai et al., 2021; Wilder, 2021). However, the greatest impact of isolation and loneliness was on the elderly population (Wu, 2020) and people with disabilities (Lebrasseur et al., 2020). Lack of access to health care further intensified the already existing challenges for the ones with disabilities (Lebrasseur et al., 2020).

Even before the onset of the pandemic, the mental health of researchers, particularly that of doctoral students, had been a point of concern (Else, 2021; Nagy et al., 2021; Scott & Takarangi, 2019). Academic settings often impose mental health stressors such as depression, anxiety, periods of intense stress, burnout, and imposter syndrome (Makani, 2021). Furthermore, about one-third of 6300 early career researchers reported to sought help during their doctoral studies (Byrom, 2020; Woolston, 2019). Additionally, the pandemic has introduced many new challenges, further worsening the situation. For instance, according to Wasil et al. (2020), COVID-19 has doubled the signs of depression and anxiety.

Though many studies examined the factors influencing the mental health of early career researchers and graduate students during the COVID-19 lockdowns (Browning et al., 2021; Wasil et al., 2020; Woolston, 2020), not many focused on the mental health of doctoral students. This study aims to bridge that gap. Studies have shown that an encouraging environment significantly improves student success (Baeten et al., 2010; Ivankova & Stick, 2007). Therefore, through this study, we aim to identify the influential factors that affect doctoral students' mental

health which would help universities and supervisors develop strategies to support the emotional and intellectual needs of their students, thus improving student experience, and subsequently student success (Saavedra et al., 2018).

Study Population

This study's data set was obtained from a cross-sectional survey conducted by Smarten and Vitae to assess the consequences of COVID-19 on mental well-being, research work, and social connections. The data can be accessed online via Figshare, an online platform for collaborating on scientific data and results (Byrom & Metcalfe, 2020). The survey was conducted in April 2020, during the initial breakout of COVID-19, which was rapidly followed by a subsequent series of lockdowns. This study is based on 4274 doctoral students from a survey of 5902 early career researchers. To ensure participant anonymity, respondent identification was removed by the original authors of the data set. Informed consent was obtained from all individual participants included in the study by the original authors of the data set.

Measures: Psychological Scales

Psychological scales used in this study include:

- *Warwick-Edinburgh Mental Well-being scale (WEMWBS)*: As a measure of mental well-being, the 7-item WEMWBS was considered. The 7-item WEMWBS is used to assess subjective well-being and psychological functioning. A WEMWBS raw score is usually constructed by summing the responses of seven questions, whose responses range from 1 (*none of the time*) to 5 (*all of the time*). Thus, the corresponding range of WEMWBS raw score is 7–35. Instead of using the raw score in the analysis, Warwick Medical School (2007a) recommends using the WEMWBS score. A lower value of transformed WEMWBS score is interpreted as lower chances of negative mental well-being (Warwick Medical School, 2007b).
- *UCLA 3-item Loneliness Scale*: Aspects of loneliness are effectively measured using the 3-item UCLA loneliness scale. The responses to the three questions include three categories: 1 (*hardly ever*), 2 (*some of the time*), and 3 (*often*). Thus, constructing the range of the UCLA loneliness scale from 3 to 9. The higher the UCLA score, the greater the chances of loneliness or social isolation (Russell et al., 1978).
- *K-6 Distress Scale*: The 6-item Kessler psychological distress scale is a measure of mental distress and helps screen for mental health issues like anxiety and depression. The scale has six questions that measure the various reactions to distress, including nervousness, hopelessness, restlessness, jitteriness, sadness, and feeling of being worthy. The response to each of these six questions is on a 5-point Likert-type scale of 0 (*none of the time*) to 4 (*all of the time*); thus, the

resulting distress score ranges from 0 to 24. Higher values of distress score indicate a higher risk of psychological distress (Kessler et al., 2003).

Methods

Prior to data analysis, this study conducted data pre-processing and exploration using SAS software, version 9.4. Data cleansing and removal of missing values were a part of data pre-processing. All analyses were conducted at a 0.05 significance level (α).

Independent Variables

Variables in the data set included questions related to (a) psychological scores: UCLA loneliness, and K-6 distress; (b) social connection to peers and/or colleagues; (c) influence of lockdown on social contact; (d) student status (part-time or full-time); (e) year of study; (f) final year of study; (g) change in dissertation deadline; (h) end date for current funding; (i) extension of research funding; (j) impact on finances for the next academic year; (k) employment outside academia; (l) impact on work; (m) impact on research tools; (n) supervisor support; (o) university support; (p) stress factors related to family, lifestyle, and employment; (q) caregiving responsibilities; (r) change in caregiving responsibilities; (s) impact of caregiving responsibilities on work; (t) citizenship; (u) affiliation to Russell Group University; (v) socio-demographic characteristics; and (w) disability status.

Out of 127 variables from the original data set, 27 were considered as independent factors or characteristics in this study. Some of these 27 characteristics include aforementioned psychological scores. Records with missing data were removed prior to data analysis. A total of 778 records were eligible for data analysis.

Covariates

Age, gender, and ethnicity were considered as covariates in the study since these characteristics often reveal a distinct trend across different subgroups (Barnard, 2013; Khumalo et al., 2012). Gender was merged into three possible categories: *male*, *female*, and *others* due to its sparse population across different subgroups, while ethnicity was recategorized into *White*, *Asian*, *Black*, and *others*.

Dependent Variable

WEMWBS score was the outcome of interest in this study.

Exploratory Data Analysis

Exploratory data analysis was the first step to the data analysis. Distribution of individual predictors was assessed using summary statistics, boxplots, and scatterplots with respect to the WEMWBS score. Furthermore, the Pearson and Spearman correlation coefficients were used to assess the correlation between the possible predictors.

Association Between the WEMWBS Score and the Independent Variables

To analyze the relationship between the WEMWBS score and individual predictors, generalized linear models (Kutner et al., 2013) were used and the unadjusted estimates along with 95% confidence intervals (CI) were calculated. Using potential covariates such as age, gender, and ethnicity in the model, the adjusted estimates along with 95% CI were calculated. Model assumptions were then assessed using residual analysis, followed by evaluating the model's multicollinearity using variation inflation factor (VIF). To add a step further, the stepwise selection method was added as a part of the data analysis. Stepwise variable selection is a method that aims to find the most significant predictors in the model. Power calculations showed that the models had more than 80% power.

Figure 1 shows the flow diagram of this study. The flow chart illustrates the record counts at each phase of the study.

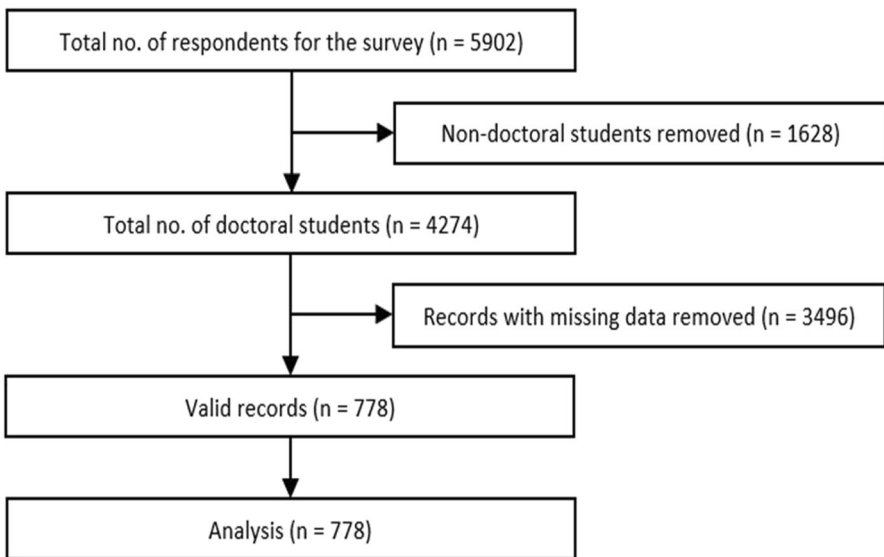


Fig. 1 Study flow diagram

Table 1 Descriptive summary statistics for WEMWBS score

Mean	Median	Std. dev	Min	Max
18.09	17.98	4.16	7.00	35.00

Table 2 Association between WEMWBS score and the covariates

Characteristics	<i>n</i> (%)	Estimates (95% CI)	<i>p</i> -value
Age (years)			<0.0001*
Under 20	2 (0.26)	7.36 (1.67, 13.05)	
21–25	154 (19.79)	−0.56 (−1.35, 0.23)	
31–35	115 (14.78)	−0.80 (−1.68, 0.07)	
36–40	84 (10.80)	0.53 (−0.46, 1.52)	
41–50	69 (8.87)	0.62 (−0.45, 1.69)	
51–60	37 (4.76)	2.82 (1.43, 4.22)	
61–70	7 (0.90)	0.06 (−3.00, 3.13)	
Over 70	1 (0.13)	−1.18 (−9.21, 6.86)	
26–30 ^R	309 (39.72)		
Gender			0.072
Female	513 (65.94)	−0.71 (−1.35, −0.07)	
Others	28 (3.60)	0.10 (−1.52, 1.73)	
Male ^R	237 (30.46)		
Ethnicity			0.438
Black	27 (3.47)	−1.10 (−2.70, 0.51)	
Asian	44 (5.66)	0.43 (−0.84, 1.71)	
Others	98 (12.60)	−0.28 (−1.17, 0.60)	
White ^R	609 (78.28)		

^RReference level*Statistically significant effects (*p*-value < 0.05)

Results

Dependent Variable

The exploratory analysis confirmed that the outcome, WEMWBS score, was normally distributed with six potential outliers. Table 1 represents the five summary descriptive statistics for the WEMWBS score.

Mental Well-being and the Independent Variables

Tables 2, 3, and 4 show the association between the WEMWBS score and the individual characteristics considered in this study. Age was found to be statistically significant among the socio-demographic characteristics. Gender was found to be borderline significant while disability status and ethnicity were not statistically significant.

Table 3 Association between WEMWBS score and categorical independent characteristics ($n = 778$)

Characteristics	n (%)	Estimates (95% CI)		p -value
		Unadjusted	Adjusted	
Disability				0.188
Yes	169 (21.72)	-0.48 (-1.18, 0.23)	-0.61 (-1.32, 0.1)	
No ^R	609 (78.28)			0.745
UK citizenship				
No	247 (31.75)	0.1 (-0.52, 0.73)	0.38 (-0.28, 1.05)	
Yes ^R	531 (68.25)			0.317
Affiliated to a Russell Group University				
No	359 (46.14)	0.3 (-0.29, 0.89)	0.05 (-0.54, 0.64)	
Yes ^R	419 (53.86)			0.004*
Whether the student is part-time or full-time				
Part-time	88 (11.31)	1.36 (0.45, 2.28)	0.91 (-0.08, 1.9)	
Full-time ^R	690 (88.69)			0.290
Year of study (years)				
2	199 (25.58)	-0.90 (-1.75, -0.06)	-0.92 (-1.75, -0.08)	
3	246 (31.62)	-0.08 (-0.88, 0.72)	-0.14 (-0.96, 0.68)	
4	125 (16.07)	-0.35 (-1.3, 0.6)	-0.3 (-1.27, 0.67)	
5	21 (2.70)	0.19 (-1.69, 2.07)	-0.58 (-2.47, 1.3)	
6	10 (1.29)	-0.57 (-3.22, 2.08)	-1.43 (-4.27, 1.4)	
1 ^R	177 (22.75)			0.653
Final year of study				
Yes	359 (46.14)	0.13 (-0.45, 0.72)	0.17 (-0.43, 0.78)	
No ^R	419 (53.86)			0.051
Change in dissertation deadline submission since COVID-19				

Table 3 (continued)

Characteristics	<i>n</i> (%)	Estimates (95% CI)		<i>p</i> -value
		Unadjusted	Adjusted	
Yes	108 (13.88)	0.84 (− 0.00, 1.69)	0.7 (− 0.14, 1.55)	0.0002*
No ^R	670 (86.12)			
End date for current funding				
Jul–Sept 2020	154 (19.79)	0.30 (− 0.98, 1.58)	0.22 (− 1.05, 1.49)	0.0002*
Oct–Dec 2020	60 (7.71)	0.80 (− 0.71, 2.32)	0.84 (− 0.66, 2.34)	
Jan–June 2021	74 (9.51)	0.92 (− 0.53, 2.36)	0.79 (− 0.65, 2.23)	
July–Dec 2021	165 (21.21)	− 0.20 (− 1.46, 1.07)	− 0.17 (− 1.43, 1.10)	
2022	158 (20.31)	0.53 (− 0.75, 1.81)	0.69 (− 0.60, 1.98)	
2023	79 (10.15)	0.02 (− 1.41, 1.44)	0.03 (− 1.42, 1.48)	
2024	20 (2.57)	3.12 (1.01, 5.23)	2.70 (0.55, 4.84)	
2025 or later	15 (1.93)	4.52 (2.17, 6.87)	3.92 (1.56, 6.28)	
April–June 2020 ^R	53 (6.81)			
Extension of research funding since COVID-19				
Yes	52 (6.68)	− 0.74 (− 1.9, 0.43)	− 0.58 (− 1.74, 0.58)	<0.0001*
No ^R	726 (93.32)			
Social connection to peers and/or colleagues in the past 2 weeks				
None of the time	156 (20.05)	− 10.08 (− 11.53, − 8.62)	− 9.99 (− 11.43, − 8.54)	<0.0001*
A little of the time	263 (33.80)	− 7.89 (− 9.30, − 6.48)	− 7.78 (− 9.19, − 6.37)	
Some of the time	222 (28.53)	− 6.20 (− 7.63, − 4.77)	− 6.05 (− 7.47, − 4.62)	
Most of the time	111 (14.27)	− 4.27 (− 5.77, − 2.77)	− 4.18 (− 5.67, − 2.69)	
All of the time ^R	26 (3.34)			
Influence of lockdown on social contact				
I feel more lonely since the lockdown	511 (65.68)	− 3.03 (− 4.11, − 1.95)	− 2.95 (− 4.03, − 1.87)	<0.0001*

Table 3 (continued)

Characteristics	n (%)	Estimates (95% CI)		p-value
		Unadjusted	Adjusted	
There has been no change	212 (27.25)	0.16 (-1.00, 1.31)	0.11 (-1.04, 1.25)	
I feel less lonely since the lockdown	55 (7.07)			
Change in relationship with the university due to COVID-19				
More negative	257 (33.03)	-3.04 (-4.22, -1.86)	-2.92 (-4.11, -1.74)	<0.0001*
No change	468 (60.15)	-0.57 (-1.70, 0.56)	-0.57 (-1.71, 0.56)	
More positive ^d	53 (6.81)			
Employment outside academia				
Yes	413 (53.08)	0.21 (-0.37, 0.80)	0.15 (-0.44, 0.74)	0.473
No ^R	365 (46.92)			
Impact on finances for the next academic year				
No	180 (23.14)	1.39 (0.71, 2.08)	1.44 (0.76, 2.13)	<0.0001*
Yes ^R	598 (76.86)			
Caregiving responsibilities				
Yes	206 (26.48)	-0.23 (-0.89, 0.43)	-0.70 (-1.43, 0.02)	0.499
No ^R	572 (73.52)			
Change in caregiving responsibilities				
Decreased to some extent	1 (0.13)	5.01 (-3.14, 13.17)	3.66 (-4.44, 11.76)	0.255
Decreased considerably	3 (0.39)	2.88 (-1.83, 7.70)	3.5 (-1.16, 8.16)	
Increased to some extent	62 (7.97)	-0.46 (-1.54, 0.63)	-0.64 (-1.74, 0.45)	
Increased considerably	118 (15.17)	-0.56 (-1.38, 0.26)	-0.98 (-1.87, -0.1)	
Unchanged ^R	594 (76.35)			
Impact of caring giving responsibilities on work needs				
Negative	81 (10.41)	1.47 (0.22, 2.72)	1.75 (0.47, 3.02)	0.014*

Table 3 (continued)

Characteristics	<i>n</i> (%)	Estimates (95% CI)		<i>p</i> -value
		Unadjusted	Adjusted	
No impact	608 (78.15)	1.55 (0.62, 2.48)	2.07 (1.09, 3.05)	
Positive	2 (0.26)	1.01 (-4.79, 6.82)	0.45 (-5.29, 6.20)	
Strongly positive	0 (0.00)			
Strongly negative ^a	87 (11.18)			

^aReference level^{*}Statistically significant effects (*p*-value < 0.05)

Table 4 Association between WEMWBS score and continuous independent characteristics ($n = 778$)

Characteristics	Value range	Mean (Std. dev)	Estimates (95% CI)		<i>p</i> -value
			Adjusted		
			Unadjusted	Adjusted	
Impact of COVID-19 on work	2–8	6.6 (1.31)	–0.27 (–0.49, –0.05)	–0.24 (–0.46, –0.02)	0.0180 *
Impact of COVID-19 on research tools	0–8	5.27 (1.38)	–0.39 (–0.60, –0.18)	–0.40 (–0.61, –0.19)	0.0003 *
Information and support from university during COVID-19	6–30	18.27 (5.72)	0.24 (0.19, 0.29)	0.23 (0.18, 0.28)	<0.0001 *
Support from the PhD Supervisor/supervisory team/line manager since COVID-19	6–30	22.13 (6.54)	0.14 (0.09, 0.18)	0.14 (0.10, 0.18)	<0.0001 *
Stress factors ^a	10–44	27.01 (5.76)	–0.33 (–0.37, –0.28)	–0.34 (–0.38, –0.29)	<0.0001 *
UCLA 3-item Loneliness Scale	3–9	6.11 (1.93)	–1.14 (–1.27, –1.01)	–1.14 (–1.27, –1.01)	<0.0001 *
K-6 Distress Scale	0–24	10.66 (5.21)	–0.57 (–0.60, –0.53)	–0.57 (–0.60, –0.53)	<0.0001 *

^aStress or worry associated with friends or family, children, living conditions, job safety, visa, and usual livelihood circumstances

*Statistically significant effects (p -value < 0.05)

Among the other characteristics, the statistically significant characteristics were as follows: (a) student status (part-time or full-time); (b) end date of current funding; (c) social connection; (d) influence of lockdown on social contact; (e) change in relationship with university; (f) impact on finances for the next academic year; (g) impact of caregiving responsibilities on work; (h) impact on work; (i) impact on research tools; (j) university support; (k) supervisor support; (l) everyday stressors related to family, lifestyle, and employment; (m) feelings of loneliness; and (n) feelings of distress. However, adjusting for the covariates, student status was no longer significant. When corrected for multiple comparisons using Benjamini-Hochberg (BH) adjustment, no significant differences in the association between the WEMWBS score and the independent characteristics were identified (adjusted p-value not included).

The results from the stepwise selection method showed similar results. Using SBC as the default stopping criterion, the stepwise selection method indicated social connection as the most influential factor affecting the mental well-being of doctoral students, followed by caregiving responsibilities, feelings of distress, and loneliness. Furthermore, everyday stressors related to family, lifestyle, and employment were also identified to be significantly impacting doctoral students' mental health.

Residual analysis of the individual and the stepwise selected generalized linear model showed that none of the model assumptions was violated. Additionally, outlier analysis showed that none of the outliers was influential. Though Pearson and Spearman correlation coefficients indicated that social connection and influence of lockdown on social contact are correlated alongside feelings of loneliness and distress, the VIF value from the stepwise selected model showed that multicollinearity was not prevalent in the model (data not included).

Discussion

The results from this study confirm that the key determinants affecting the mental health of doctoral students have not altered significantly since the pandemic. Personal and academic isolation related to loneliness, distress, and social connection were identified as the primary factors threatening the psychological well-being of doctoral students in the past. Studies conducted prior to COVID-19 (Akhter & Khalek, 2020; Janta et al., 2014) identified loneliness and social connection as important elements affecting the mental health of doctoral students. Alongside the stress of academia, the global lockdowns during the initial outbreak of COVID-19 majorly disrupted the social connections with peers, friends, and family, thus, magnifying the feelings of loneliness and distress, eventually impacting the mental well-being of doctoral students.

This study was able to identify university and supervisor support alongside the impact on finances as the characteristics that affected the mental health of doctoral students. Factors like organizational support, supervisor interactions, and deadline stress were also highlighted as factors of major concerns in the past studies (Akhter & Khalek, 2020; Saavedra et al., 2018; Scott & Takarangi, 2019).

Unlike some of the past studies, the results did not deem changes in deadlines, and caregiving responsibilities as a significant characteristic associated with the mental health of doctoral students. The possible explanation could be related to the online

mode of study, where universities and supervisors have been more flexible with deadlines (Armstrong-Mensah et al., 2020), thus, making it easier for students to manage stress at home and school. Moreover, changes in caregiving responsibilities had major class imbalances; thus, there is a possibility that the true association was not captured.

The impact of caregiving responsibilities on work and everyday stressors related to family, lifestyle, and employment was identified as significant predictors. Some studies reported that doctoral students would frequently feel burned out between household and employment responsibilities (Breitenbach et al., 2019; Woolston, 2019). As a result, graduate students would often indulge themselves in physical activities, such as exercise and cycling, or stress-relieving activities, such as yoga (Kumar & Cavallo, 2018). However, with the subsequent lockdowns during the initial phase, outdoor activities and gyms were completely shut down which could have eventually led to more stress, thus, increasing the chances of deteriorating mental health.

The results from this study show that gender was borderline significant; thus, no comment could be made on the association of doctoral students' mental well-being with gender, whereas past studies were able to identify distinct discrimination based on gender and sexuality when assessing doctoral students' mental health (Else, 2021; Woolston, 2019). This could be related to the fact that the majority of the survey respondents were females. The percentage of *other* gender category, such as the subgroups representing LGBTQ+, was very low. Therefore, the impact of COVID-19 on marginalized gender categories could not be confirmed. Also, the survey did not collect any information on the sexuality of the respondents; thus, no valid conclusion could be drawn on the same.

The study result demonstrated age to be influential on the mental health of doctoral students. Reports have confirmed that the elderly population was the most afflicted by the pandemic (Wu, 2020); however, this could not be confirmed by the study since the percentage of adult respondents above 70 years was very small.

The strengths of this study include its fairly high sample size and the availability of several characteristics related to both the academic and social lives of doctoral students. One of the weaknesses of the study was the unbalanced data across multiple groups. The study's validity could be enhanced further by employing imputation methods to treat missing values rather than eliminating observations. Further, due to data unavailability, the study was unable to analyze the true association across different age categories (such as those under 20 or over 70) or ethnic groups other than White, Black, and Asian. Also, the study did not investigate the interaction across different characteristics.

Since this study is based on the data collected during the initial phase of COVID-19, some social factors may have been altered with global vaccination in place and the pandemic lasting more than a year. Also, the respondents of this survey were primarily based in the UK and might not have captured diverse socio-demographics.

Conclusion

Future studies could be conducted by consolidating data from all over the world to evaluate the pandemic's global consequences on the mental health of doctoral students. Since few studies have focused on marginalized population groups

based on disability and the LGBTQ+ community, the potential future scope of work could be extended to the mental well-being of doctoral students within such closed population groups. Understanding the concerns and challenges of these minority groups, which are often at a higher risk of compromised mental health, would help universities and supervisors prepare themselves to support the unique needs of doctoral researchers across all spectrums.

Acknowledgements The authors would like to thank Sharon A. Fitzgerald-Wolff for her valuable feedback and constructive criticism without which the completion of this research work would not have been possible. The authors would also like to extend their gratitude to Karen Doerr at the University of Kansas Medical Center for her meticulous review and suggestions.

Data Availability The data can be accessed online via Figshare, *Byrom, N., & Metcalfe, J. (2020). Impact of COVID 19 on doctoral and early career researchers. figshare. 10.6084/m9.figshare.12361493.v1.*

Declarations

The views, thoughts, opinions, and conclusions made in this research work are solely those of the authors and do not necessarily reflect the view of the authors' employer, organization, committee, or other group or individual. The findings in this paper are a joint collaboration among independent professionals and are not sponsored by any agency or institution.

Informed Consent Informed consent was obtained from all individual participants included in the study by the original authors of the data set.

Conflict of Interest The authors declare no competing interests.

References

- Akhter, M. S., & Khalek, M. A. (2020). Association between psychological wellbeing and problematic internet use among university students of Bangladesh. *Journal of Technology in Behavioral Science*, 5(4), 1–3. <https://doi.org/10.1007/s41347-020-00142-x>
- Alon, T., Doepke, M., Olmstead-Rumsey, J., & Tertilt, M. (2020). The impact of COVID-19 on gender equality. *National Bureau of Economic Research*. <https://doi.org/10.3386/w26947>
- Armstrong-Mensah, E., Ramsey-White, K., Yankey, B., & Self-Brown, S. (2020). COVID-19 and distance learning: Effects on Georgia State University school of public health students. *Frontiers in Public Health*, 8, 547. <https://doi.org/10.3389/fpubh.2020.576227>
- Baeten, M., Kyndt, E., Struyven, K., Dochy, F. (2010). Using student-centred learning environments to stimulate deep approaches to learning: Factors encouraging or discouraging their effectiveness. *Educational Research Review*, 5 <https://doi.org/10.1016/j.edurev.2010.06.001>
- Barnard, A. (2013). The role of socio-demographic variables and their interaction effect on sense of coherence. *SA Journal of Industrial Psychology*, 39(1), 1–9. <https://doi.org/10.4102/sajip.v39i1.1073>
- Bateman, N., & Ross, M. (2020). Why has COVID-19 been especially harmful for working women. *Brookings.edu*.
- Bernstein, J., & Jones, J. (2020). The impact of the COVID-19 recession on the jobs and incomes of persons of color. *Center on Budget and Policy Priorities*, 1.
- Breitenbach, E., Bernstein, J., Ayars, C. L., & Konecny, L. T. (2019). The influence of family on doctoral student success. *International Journal of Doctoral Studies*, 14, 761–782. <https://doi.org/10.28945/4450>
- Browning, M. H. E. M., Larson, L. R., Sharaievska, I., Rigolon, A., McAnirlin, O., Mullenbach, L., Cloutier, S., Vu, T. M., Thomsen, J., Reigner, N., Metcalf, E. C., D'Antonio, A., Helbich, M., Bratman, G. N., & Alvarez, H. O. (2021). 01). Psychological impacts from COVID-19 among university

- students: Risk factors across seven states in the United States. *PLoS ONE*, 16, 1–27. <https://doi.org/10.1371/journal.pone.0245327>
- Byrom, N. (2020). COVID-19 and the research community: The challenges of lockdown for early-career researchers. *eLife*, 9, e59634. <https://doi.org/10.7554/eLife.59634>
- Byrom, N., & Metcalfe, J. (2020). Impact of COVID 19 on doctoral and early career researchers. Figshare. <https://doi.org/10.6084/m9.figshare.12361493.v1>
- CDC (2021). Older adults at greater risk of requiring hospitalization or dying if diagnosed with COVID-19. *Center for Disease Control and Prevention*. Retrieved 29 June 2021, from <https://www.cdc.gov/coronavirus/2019-ncov/need-extraprecautions/older-adults.html>
- Chapman, A. (2020). Ameliorating COVID-19's disproportionate impact on black and hispanic communities: Proposed policy initiatives for the United States. *Health and Human Rights Journal*, 22(2), 329–332.
- Else, H. (2021). Largest-ever survey exposes career obstacles for LGBTQ scientists. *Nature*. <https://doi.org/10.1038/d41586-021-00221-w>
- Gould, E.L., Perez, D., Rawlston-Wilson, V. (2020). Latinx workers—particularly women—face devastating job losses in the COVID-19 recession. *Economic Policy Institute*. Retrieved 29 June 2021, from <https://www.epi.org/publication/latinx-workers-covid/>
- Ivankova, N.V., & Stick, S.L. (2007). Students' persistence in a distributed doctoral program in educational leadership in higher education: A mixed methods study. *Research in Higher Education*, 43 <https://doi.org/10.1007/s11162-006-9025-4>
- Janta, H., Lugosi, P., & Brown, L. (2014). Coping with loneliness: A netnographic study of doctoral students. *Journal of Further and Higher Education*, 38(4), 553–571. <https://doi.org/10.1080/0309877X.2012.726972>
- Kessler, R. C., Barker, P. R., Colpe, L. J., Epstein, J. F., Gfroerer, J. C., Hiripi, E., Howes, M. J., Normand, S. T., Manderscheid, R. W., Walters, E. E., & Zaslavsky, A. M. (2003). Screening for serious mental illness in the general population. *Archives of General Psychiatry*, 60(2), 184–189. <https://doi.org/10.1001/archpsyc.60.2.184>
- Khumalo, I., Temane, Q., & Wissing, M. (2012). Socio-demographic variables, general psychological well-being and the mental health continuum in an African context. *Social Indicators Research*, 105(3), 419–442. <https://doi.org/10.1007/s11205-010-9777-2>
- Kumar, S., & Cavallaro, L. (2018). Researcher self-care in emotionally demanding research: A proposed conceptual framework. *Qualitative Health Research*, 28(4), 648–658. <https://doi.org/10.1177/1049732317746377>
- Kutner, M., Nachtsheim, C.J., Neter, J., Li, W. (2013). Applied linear statistical model. *McGraw Hill Education*.
- Lavine, J. S., Bjornstad, O. N., & Antia, R. (2021). Immunological characteristics govern the transition of COVID-19 to endemicity. *Science*, 371(6530), 741–745. <https://doi.org/10.1126/science.abc6522>
- Lebrasseur, A., Fortin-Bedard, N., Lettre, J., Bussi eres, E.-L., Best, K., Boucher, N., Mathieu, H., Beaulieu-Bonneau, S., Mercier, C., Lamontagne, M.-E., Routhier, F. (2020). Impact of COVID-19 on people with physical disabilities: A rapid review. *Disability and Health Journal*, 101014 <https://doi.org/10.1016/j.dhjo.2020.101014>
- Makani, N.E. (2021, May). Q&A: Why discuss mental health in academia? *Stanford Earth*. Retrieved from <https://earth.stanford.edu/news/qa-why-discuss-mentalhealth-academia>. Accessed 01 June 2021
- McKnight-Eily, L.R., Okoro, C.A., Strine, T.W., Verlenden, J., Hollis, N.D., Nja, R., Mitchell, E.W., Board, A., Puddy, R., Thomas, C. (2021). Racial and ethnic disparities in the prevalence of stress and worry, mental health conditions, and increased substance use among adults during the COVID-19 pandemic — United States, April and May 2020. *MMWR Morb Mortal Wkly Rep*, 70. *Impact of COVID-19 on the Mental Well-being of Doctoral Students* <https://doi.org/10.15585/mmwr.mm7005a3>
- Nagy, G.A., Fang, C.M., Hish, A.J., Kelly, L., Nicchitta, C.V., Dzirasa, K., Rosenthal, M.Z. (2021). Burnout and mental health problems in biomedical doctoral students. *CBE-Life Sciences Education*, 18 <https://doi.org/10.1187/cbe.18-09-0198>
- Petrowski, N., Cappa, C., Pereira, A., Mason, H., & Daban, R. A. (2021). Violence against children during COVID-19: Assessing and understanding change in use of helplines. *Child Abuse & Neglect*, 116, 104757. <https://doi.org/10.1016/j.chiabu.2020.104757>
- Phillips, N. (2021). The coronavirus is here to stay — Here's what that means. *Nature*, 590(7846), 382–384. <https://doi.org/10.1038/d41586-021-00396-2>

- Russell, D., Peplau, L. A., & Ferguson, M. L. (1978). Developing a measure of loneliness. *Journal of Personality Assessment*, 42(3), 290–294. <https://doi.org/10.1207/s15327752jpa420311>
- Saavedra, P., Ntontis, E., & Kyprianides, A. (2018). PhD supervisors and faculty members might help to avoid burnout as well as enhance engagement and organisational citizenship behaviour (OCB) among PhD students. *University of Sussex*. [https://doi.org/10.20919/Psych\(2019\).001](https://doi.org/10.20919/Psych(2019).001)
- Scott, H., & Takarangi, M. K. (2019). Measuring PhD student's psychological wellbeing: Are we seeing the whole picture? *Student Success*, 10(3), 14. <https://doi.org/10.5204/ssj.v10i3.1294>
- Tai, D.B.G., Shah, A., Doubeni, C.A., Sia, I.G., Wieland, M.L. (2021). The disproportionate impact of COVID-19 on racial and ethnic minorities in the United States. *Clinical Infectious Diseases*, 72(4). <https://doi.org/10.1093/cid/ciaa815>
- Venkatesh, V. (2020). Impacts of COVID-19: A research agenda to support people in their fight. *International Journal of Information Management*, 55, 102197. <https://doi.org/10.1016/j.ijinfomgt.2020.102197>
- Warwick Medical School (2007a). *Collect, score, analyse and interpret WEMWBS*. Retrieved 01 June 2021, from <https://warwick.ac.uk/fac/sci/med/research/platform/wemwbs/using/>
- Warwick Medical School (2007b). *The Warwick-Edinburgh Mental Wellbeing Scales - WEMWBS*. Retrieved 01 June 2021, from <https://warwick.ac.uk/fac/sci/med/research/platform/wemwbs/>
- Wasil, A. R., Taylor, M. E., Franzen, R. E., Steinberg, J. S., & DeRubeis, R. J. (2020). Promoting graduate student mental health during COVID-19: Acceptability, feasibility, and perceived utility of an online single-session intervention. *Frontiers in Psychology*. <https://doi.org/10.3389/fpsyg.2021.569785>
- Wilder, J.M. (2021). The disproportionate impact of COVID-19 on racial and ethnic minorities in the United States. *Clinical Infectious Diseases*, 72(4). <https://doi.org/10.1093/cid/ciaa959>
- Woolston, C. (2019). PhDs: The tortuous truth. *Nature Career Feature*. <https://doi.org/10.1038/d41586-019-03459-7>
- Woolston, C. (2020). Signs of depression and anxiety soar among US graduate students during pandemic. *Nature*, 585 <https://doi.org/10.1038/d41586-020-02439-6>
- Wu, B. (2020). Social isolation and loneliness among older adults in the context of COVID-19: A global challenge. *Global Health Research and Policy*, 5(1), 1–3. <https://doi.org/10.1186/s41256-020-00154-3>

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.