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Prevalence of Depressive, Anxiety, and OCD Symptoms among University Students in Singapore During COVID-19

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Abstract: Using self-report screening questionnaires, this study surveyed 1779 university students twice in 2021 to estimate the prevalence of depressive, anxiety, and OCD symptoms across a six-month period during the COVID-19 pandemic in Singapore. Across two waves of measurement, results showed that the prevalence of elevated depressive and anxiety symptoms were 29-34% and 25%, respectively. The prevalence of those who met the screening criteria of OCD was 5.7-7.1%. These estimates appeared to be consistent with other studies conducted overseas during the pandemic, suggesting an increase in mental health concerns. No significant differences were consistently found across gender, race/ethnicity, household income, and year of study for this sample. Relative to depressive and anxiety symptoms, OCD symptoms showed a higher degree of stability six months later. This study contributed to the understanding of the mental health needs of the young adult population in Singapore and underscored the importance of including a systematic focus on mental well-being in the public health response to the pandemic.

Keywords: COVID-19, Depression, Anxiety, OCD, young adults, mental health, Singapore

Introduction

The negative psychological impact due to COVID-19 was predicted even before the World Health Organization declared COVID-19 as a pandemic on 11 Mar 2020 (Brooks et al., 2020). As a pandemic is known to have widespread impacts that go beyond the global and public health systems and includes effects on the economic, political, social, and psychological aspects of life, the individual can be affected both directly and indirectly by the pandemic in multiple ways. Even before the pandemic, there were already concerns about the decline in mental health among the youth (Auerbach et al., 2018; Pitchforth et al., 2018). Hence, it is important for research to provide current prevalence estimates of mental health symptoms so that we can understand the mental health needs of young people during the pandemic.

To provide a basis for comparison, research studies from Singapore and other countries that estimated prevalence or reported percentages of their samples affected by mental health symptoms, were briefly reviewed in the following sections. Since depressive and anxiety symptoms are common among young people and may indicate a risk of more severe problems, screening of these symptoms is expected to provide a realistic estimate of overall mental health problems (Auerbach et al., 2018; Cummings et al., 2014). Additionally, given that OCD has been estimated to be higher in Singapore compared to other countries (Subramanian et al., 2020), the present study based in Singapore also aimed to measure this symptomatology. While the review was not comprehensive or exhaustive in identifying all studies investigating prevalence of depression, anxiety, and OCD, it examined and summarized research in this area in Singapore.

Prevalence of depression

Based on 90 studies from 30 different countries, a meta-analysis by Lim et al. (2018) estimated the point prevalence of depression to be 12.9%, with the female to male prevalence being 14.4% to 11.5%. The studies reviewed used self-report screening instruments or diagnostic interviews to measure depression. Prevalence based on self-report scales, known as the dimensional approach (17.3%) was higher than those based on the categorical approach (8.5%) which focused on whether an individual meets a list of DSM-5 or ICD-11 diagnostic criteria. Using the Patient Health Questionnaire-9 (PHQ-9) as a dimensional measure, Busch et al. (2013) estimated the point prevalence of depressive symptoms to be 8.1% for their sample of German adults aged 18-79 years, with females (10.2%) being more at risk than males (6.1%). When measured using the standardized Computer-Assisted Personal Interview (CAPI), 6.0% of the sample met the diagnostic criteria for depression (Busch et al., 2013). Overall, prevalence based on self-report scales tends to be higher compared to estimates based on diagnostic interviews since self-report scales typically screens in individuals with subclinical levels of symptoms (Vander Stoep et al., 2012).

In Singapore, the prevalence of depression has been estimated to be 7.8-17.1% (Chuan et al., 2008; Ho et al., 2014; Kua, 1992; Magiati et al., 2015; Ng et al., 2014; Niti et al., 2007; Subramaniam et al., 2016), based on samples who were either < 13 years or \geq 55 years in age. A variety of measures were used, including the Children's Depression Inventory (CDI), Geriatric Depression Scale-15 (GDS-15), and Geriatric Mental State-Automated Geriatric Examination for Computer Assisted Taxonomy (GMS-AGECAT). Two studies using the categorical approach reported clinical depression to be 3.8% and 4.4% in adults (>18 years) (Chong et al., 2012; Subramaniam et al., 2019). Based on dimensional scales, the prevalence of depressive symptoms appeared to be comparable to estimates from overseas; however, based on the categorical approach, estimates of depression in Singapore seemed lower.

Investigating the impact of the pandemic, Ettman et al. (2020) directly compared the prevalence of depressive symptoms before and after the onset of COVID-19. Prior to COVID-19, they found that 8.5% of their participants showed elevation of depressive symptoms with a higher preponderance of females (10.1% versus 6.9% males) and lower-income participants. During COVID-19, the same study reported a prevalence of 27.8%, which was three times higher than before. Females (33.3% versus 21.9% males) and lower-income participants remained vulnerable. Overall, evidence showed an increase in the prevalence of depressive symptoms during COVID-19.

Prevalence of anxiety

According to another meta-analysis of 87 studies across 44 different countries, Baxter et al., (2012) estimated the point prevalence of 7.3% for anxiety disorders as measured using the categorical approach. Females were twice more likely than men to have anxiety disorders. In Singapore, a lower point estimate of 2.1% was found for anxiety disorders in an adult sample (\geq 18 years) (Lee et al., 2015). On the other hand, using a dimensional approach that measured anxiety based on two items from the Generalized Anxiety Disorder rating scale (GAD-2), Twenge and Joiner (2020) estimated a slightly higher prevalence of 8.2% for their representative sample of U.S. adults. Although not comparable in terms of the age group, one study in Singapore provided an estimate of 9.3% for children aged 8-12 years old (Magiati et al., 2015). No other study investigated anxiety in an adult sample in Singapore. Similar to depression, the prevalence of anxiety has been estimated to be lower in Singapore than in other countries.

During the pandemic, Twenge & Joiner (2020) found that anxiety symptoms increased by more than three-fold from an earlier estimate of 8.2% to 30.8%. This result was consistent with the results of a meta-analysis which estimated a prevalence of 25% for anxiety symptoms across 43 studies (Santabárbara et al., 2021). Overall, clear evidence showed an increase in the prevalence of anxiety symptoms during COVID-19.

Prevalence of OCD

A meta-analysis by Fawcett et al. (2020) analyzed 34 studies and found that the overall current, 12-month and lifetime OCD prevalence was 1.1%, 0.8% and 1.3% respectively. Based on respondents who met OCD diagnostic criteria, females were 1.6 times more likely than men to be diagnosed with OCD, with the lifetime prevalence of 1.5% compared to 1.0% for males. According to a comparable study in Singapore, the 12-month and lifetime prevalence of OCD was 2.9% and 3.6%. These appeared higher than those from other countries (Subramanian et al., 2020). Additionally, evidence also showed that the young adult population may show a higher prevalence of OCD compared to the general population (Yoldascan et al., 2009).

During the COVID-19 pandemic, Abba-Aji et al. (2020) found an increase in elevated OCD symptoms in Canada. Using an online survey, OCD was measured by two items - “worrying about dirt, germs, and viruses...” and “...wash my hands very often or in a special way...”. Based on the respondents’ self-report of whether those behaviors occurred during the pandemic, before the pandemic, or never at all, Abba-Aji et al. (2020) concluded that the prevalence of OCD during the early part of the pandemic was higher than pre-COVID-19 periods.

Goals of the Present Study

While many studies have investigated the prevalence of mental health conditions among the older adults in Singapore, few or none have focused on the young adult population. Hence, the goals of the present study were to provide estimates of the point prevalence of depressive, anxiety, and OCD symptoms in the young adult university population, as well as to estimate their stability over a six-month period during the pandemic. Differences based on gender, ethnicity, and income levels were also investigated. Given evidence from overseas studies showing a significant increase in symptomatology during COVID-19, we hypothesized that the prevalence of symptoms in Singapore would be higher compared to before the onset of COVID-19. Furthermore, the current higher estimates would be comparable to those estimates obtained from other countries after the onset of COVID-19.

Method

Participants

The data for the present study came from the second and third waves of a three-wave longitudinal project on the psychological impact of COVID-19 pandemic. The main survey included measures related to stress and coping, school functioning, and mental health services. However, only data from a few measures were used in this present study. The initial sample size of 2,345 undergraduate students was approximately 9.8% of the university’s undergraduate population. Seven students did not meet eligibility criteria as they were over 30 years old or/and in their fifth year of

study. Additionally, due to nonresponse to invitations and to survey links, the sample sizes at the second and third point of measurement became 1,779 and 1,150 students, respectively. The sample sizes and demographic information of the subsamples in Wave A and Wave B are presented in Table 1.

Table 1

+Demographic information for Wave A and Wave B samples and subsamples

		Wave A (Mar-May 2021)			Wave B (Sep-Nov 2021)		
		OCD			OCD		
		Total sample	PHQ subsample	GAD subsample	Total sample	PHQ subsample	GAD subsample
Age (years)	Sample size	1779	400	400	1150	245	236
	Mean (SD)	21.59 (1.92)	21.61 (1.99)	21.67 (1.87)	21.54 (1.87)	21.71 (1.98)	21.56 (1.83)
Gender	Female	1027 (60.1%)	230 (59.0%)	242 (61.1%)	661 (61.9%)	140 (60.1%)	144 (64.0%)
	Male	681 (39.9%)	160 (41.0%)	154 (38.9%)	407 (38.1%)	93 (39.9%)	81 (36.0%)
Ethnicity	Chinese	1515 (87.5%)	337 (86.6%)	343 (87.3%)	1009 (90.2%)	216 (89.3%)	209 (89.3%)
	Malay	70 (4.0%)	18 (4.6%)	14 (3.6%)	41 (3.7%)	11 (4.5%)	11 (4.7%)
	Indian	83 (4.8%)	18 (4.6%)	19 (4.8%)	41 (3.7%)	8 (3.3%)	6 (2.6%)
	Others	64 (3.7%)	16 (4.1%)	17 (4.3%)	28 (2.5%)	7 (2.9%)	8 (3.4%)
Year of study ¹	Year 1/Year 2	447 (25.8%)	104 (26.7%)	94 (23.9%)	277 (24.8%)	53 (21.9%)	56 (23.9%)
	Year 2/Year 3	501 (28.9%)	106 (27.2%)	116 (29.5%)	352 (31.5%)	73 (30.2%)	78 (33.3%)
	Year 3/Year 4	463 (26.7%)	103 (26.5%)	108 (27.5%)	308 (27.5%)	73 (30.2%)	68 (29.1%)
	Year 4/Graduates	321 (18.5%)	76 (19.5%)	75 (19.1%)	182 (16.3%)	43 (17.8%)	32 (13.7%)
Household Income per month	Below \$2,000	227 (13.2%)	48 (12.0%)	50 (12.5%)	132 (12.7%)	29 (12.9%)	29 (13.1%)
	\$2,000 to \$3,999	334 (19.5%)	70 (17.5%)	73 (18.3%)	199 (19.1%)	35 (15.6%)	42 (19.0%)
	\$4,000 to \$5,999	269 (15.7%)	65 (16.3%)	72 (18.0%)	152 (14.6%)	32 (14.2%)	37 (16.7%)
	\$6,000 to \$7,999	183 (10.7%)	41 (10.3%)	41 (10.3%)	127 (12.2%)	30 (13.3%)	22 (10.0%)
	\$8,000 to \$9,999	134 (7.8%)	28 (7.0%)	31 (7.8%)	90 (8.6%)	22 (9.8%)	17 (7.7%)
	\$10,000 & above	207 (12.1%)	54 (13.5%)	43 (10.8%)	131 (12.6%)	32 (14.2%)	28 (12.7%)
	Refuse to answer	104 (6.1%)	23 (5.8%)	32 (8.0%)	57 (5.5%)	12 (5.3%)	16 (7.2%)
	Don't know	256 (14.9%)	71 (17.8%)	58 (14.5%)	154 (14.8%)	33 (14.7%)	30 (13.6%)

Note. ¹Year of study at Wave A / Year of study at Wave B. PHQ = Patient Health Questionnaire-8, GAD = Generalized Anxiety Disorders-7.

Procedure

An advertisement about the survey was emailed to undergraduate students. Interested students signed up to consent and participate in the study. Online data collection on Qualtrics took place in Mar-May 2021 (Wave A) and Sep-Nov 2021 (Wave B). The instruments used in the present study were administered only at the last two points of measurement, henceforth referred to as Wave A and Wave B. To reduce the burden of completing long surveys, participants were randomly assigned to complete one of three versions of the survey. Using a random function in Excel, a random number was generated for each participant, and the list of participants was sorted according to the random numbers. The first 1,239 participants were assigned one version of the survey; the next 550 participants were assigned to the second version; and the last 550 participants were assigned to the third version. Hence, data was not available for all participants (See Measures section below). At the end of

the surveys, about 75% and 50% of the participants were randomly selected to receive a \$10 e-voucher at the end of Wave A and B, respectively. This study received ethical approval from the Institutional Review Board at Nanyang Technological University (IRB 2020-05-035).

Measures

Patient Health Questionnaire-8 (PHQ-8)

The PHQ-8 was used to measure depressive symptoms. Participants rated their experience of eight symptoms on a 4-point scale “in the past few weeks” (1 = Not at all, 2 = Several days, 3 = More than half the days, and 4 = Nearly every day). This scale showed good reliability and validity across many studies (Thombs et al., 2014, Shin et al., 2019, Wu et al., 2019). A 10-point cutoff was used to determine clinically elevated levels of symptoms (Liu et al., 2021, Rettie & Daniels, 2021; Shin et al., 2019). This scale was included only in one version of the survey and administered to 550 participants. The internal consistency of the scale was .91 at both Wave A and B. As presented in Table 1, 400 and 245 students completed the PHQ-8 at Wave A and B, respectively.

Generalized Anxiety Disorder-7 (GAD-7)

The GAD-7 was used to measure seven symptoms of anxiety and their severity. Participants rated their experience of symptoms “in the past few weeks” on a similar 4-point scale. This scale demonstrated good reliability and validity across many studies (Lee & Yang, 2019, Sun et al., 2021, Moreno et al., 2019), and 10-point cutoff was used to determine clinically elevated levels of anxiety symptoms (Liu et al., 2021, Löwe et al., 2008, Rettie & Daniels, 2021). This scale was included only in one version of the survey and administered to 550 participants. The internal consistency estimates were .94 at both waves. As presented in Table 1, 400 and 236 students completed the GAD-7 at Wave A and B.

Obsessive-Compulsive Disorder (OCD) Screening Tool

In the 13-item OCD Screening tool, five questions were related to obsession (e.g., have unwanted ideas, images, or impulses), four questions were related to compulsions (e.g., things you feel you must do excessively or thoughts you must think repeatedly to feel comfortable or ease anxiety), and four questions were related to anxiety (e.g., experience “jelly” legs). Participants rated their experience of symptoms on a 4-point scale “in the past few weeks” (1 = Not at all, 2 = A little, 3 = Sometimes, and 4 = A lot). A review of the literature did not reveal a validated clinical cut-off score for this screening tool. Hence, a set of screening criteria were used to identify students who were at-risk of OCD. This is a recommended approach due to the wide content heterogeneity of OCD presentations that could confound the assessment of severity of symptoms, especially in cases with more specific or narrower symptom presentation (Wu, 2017). Following the DSM-5 criteria for the diagnosis of OCD, the screening criteria used were

(1) at least one symptom of obsession and at least one symptom of compulsion rated at 4 (A Lot) and (2) high levels of anxiety operationalized as the top 20% of mean scores across the four anxiety items. The internal consistency estimates of the four-item anxiety subscale were .73 and .72 at Wave A and B. This scale was included in all three versions of the survey and administered to all participants. As presented in Table 1, 1779 and 1150 students completed the OCD screening tool at Wave A and B.

Analyses

The at-risk case status for depression, anxiety, and OCD, called *caseness* (coded 1 versus 0), was assigned to participants who met the cut-off scores of ≥ 10 on PHQ-8, ≥ 10 on GAD-7, and those who met the screening criteria for OCD. Point prevalence was the proportion of the sample who met caseness for those conditions. Chi square tests of association were performed to determine if caseness differed across categories of gender, race/ethnicity, and year of study. Given a statistically significant association for contingency tables larger than 2 x 2, adjusted standardized residuals were evaluated against a conservative alpha value of .01 to account for multiple comparisons (that is, using a residual value of ± 2.58) (MacDonald & Gardner, 2000; Sharpe, 2015). Pearson's r was used to test the association between caseness and household income. Across Wave A and B, stability of caseness was evaluated using logistic regression which estimated the odds of caseness at Wave B given caseness at Wave A, while controlling for gender. Stability was indicated when the odds of caseness at Wave B was significantly predicted by caseness at Wave A and the odds ratio was > 1.0 . Another indication of stability was the significantly large correlations between the scale scores. Missingness in the dataset was found to be negligible at .62% at Wave A and 1.10% at Wave B.

Results

According to Table 2, about 29% and 34% of the sample experienced elevated depressive symptoms at Wave A and B, respectively. Female students were more likely to report depressive symptoms at Wave A, $X^2(1, n = 390) = 6.93, p < .01$, but not at Wave B. More second-year students at Wave A were experiencing elevated depressive symptoms compared to students from other levels, $X^2(3, n = 389) = 8.52, p < .01$. At Wave B, the second-year students were initially first-year students at Wave A. With this cohort of second-year students, there was no difference in depressive symptoms, compared to students from different years of study. Additionally, no significant differences were found across race/ethnicity and household income. In terms of anxiety symptoms, about 25% of the sample experienced elevated anxiety symptoms at both Wave A and B. No significant differences were found across genders, race/ethnicity, income levels, and years of study.

Table 2
Prevalence of Depressive, Anxiety, and OCD symptoms at Wave A and B

		Wave A			Wave B		
		Dep	Anx	OCD	Dep	Anx	OCD
Overall Sample	Sample Size	400	400	1779	245	236	1150
	Prevalence	115 (28.7%)	99 (24.8%)	102 (5.7%)	83 (33.9%)	58 (24.6%)	82 (7.1%)
Females	Sample Size	230	242	1027	140	144	661
	Prevalence	77 (33.5%)	59 (24.4%)	65 (6.3%)	47 (33.6%)	33 (22.9%)	51 (7.7%)
Males	Sample Size	160	154	681	93	81	407
	Prevalence	34 (21.3%)	39 (25.3%)	35 (5.1%)	31 (33.3%)	22 (27.2%)	22 (5.4%)

Note. Dep = Elevated depressive symptoms, Anx = Elevated anxiety symptoms, and OCD = Meeting screening criteria for OCD.

In terms of meeting OCD screening criteria, the respective prevalence for Wave A and B was 5.7% and 7.1%, with no significant gender differences. Other differences in meeting OCD criteria across race/ethnicity and years of study were not consistent. Only at Wave A, Malay students were more likely to meet the criteria, $X^2(3, n = 1732) = 15.50, p < .01$, Adjusted residual = 2.6, while Chinese students were less likely to meet the criteria, Adjusted residual = -3.8. Only at Wave B, second-year students were more likely to meet criteria, $X^2(3, n = 1119) = 8.33, p < .05$, Adjusted residual = 2.6. No differences in OCD caseness were found across income levels.

Results of logistic regressions showed that students who met depression caseness at Wave A were 6.16 times more likely (95% CI: 3.21, 11.82; $p < .01$) to be identified as a case at Wave B, compared to those students who did not. For anxiety and OCD, the odds ratios were 8.22 (95% CI: 3.98, 17.00, $p < .01$) and 11.75 times (95% CI: 6.25, 22.06, $p < .01$), respectively. Correlations based on Wave A and B total scale scores also showed a high degree of associations for depression ($r = .58; p < .01$), anxiety ($r = .55; p < .01$), and OCD ($r = .66; p < .01$).

Discussion

The present study aimed to estimate the prevalence of elevated depressive, anxiety, and OCD symptoms among university students in Singapore during the pandemic. Results showed a high prevalence of

elevated depressive symptoms (29-34%) based on dimensional measures of depression (PHQ-8). Before the pandemic, depression rates of 9-12% were reported for university students and the general population using similar measures (Kroenke et al., 2009; Yu et al., 2015). During the pandemic, depression rates of 22-53% (Huang & Zhao, 2020; Jane-Llopis et al., 2021; Khan et al., 2020; Odriozola-González et al., 2020; Rettie & Daniels, 2021; Sultana et al., 2021) have been reported. Hence, our results appeared to be consistent with rates reported by overseas studies. Even though estimates of depression in Singapore suggested a lower prevalence in the population before the pandemic (Chong et al., 2012; Subramaniam et al., 2019), our results did not suggest a lower risk of depression compared to other countries during the pandemic.

In terms of elevated anxiety symptoms, the present study found a prevalence of 25% for university students in Singapore. Overseas studies have estimated rates to be 15-35% during this pandemic (Huang & Zhao, 2020; Jane-Llopis et al., 2021; Rettie & Daniels, 2021; Wang et al., 2020). Hence, our estimate was also consistent with these studies. Even though previous estimates of anxiety disorders in Singapore seemed to be lower compared to other countries, current estimates of elevated anxiety symptoms among university students appear to be comparable.

Further results showed that the prevalence of OCD symptoms among the university students as determined by the screening criteria were 6-7% which were higher compared to 1-3% and 3-4% prevalence estimates based on clinical diagnosis of OCD overseas (Fawcett et al., 2020) and in Singapore (Subramaniam et al., 2020). Even though many students in our study self-reported OCD tendencies in terms of obsessive thoughts and compulsive behaviors and high levels of anxiety, some of these symptoms might not reach clinical significance (Morris et al., 2000). The higher likelihood of students experiencing OCD symptoms during the pandemic may also account for the higher estimates in this study. At least one study that measured OCD symptoms before and during COVID found direct evidence for an increase in OCD symptoms (Abba-Aji et al., 2020). While there are limits in comparing our results with other studies, the high rates based on our sample were at least, indicative of an overall increased in vulnerability for the mental health challenges during the pandemic.

When measured six months apart, evidence showed high levels of stability for all symptomatology. Results indicated that OCD symptoms appeared to be most stable, followed by anxiety and depressive symptoms. The higher stability of OCD symptoms likely applied to students experiencing subclinical levels of symptoms who might not have met clinical significance, in terms of frequency, duration, distress, reactions to thoughts, and functional impairment (Morris et al., 2000; Wu, 2017). With regards to depressive symptoms among university students, some researchers have suggested that elevated symptoms were indicative of expected and normative negative emotional response to contextual stress and hence, were more likely to be time-limited (Barker & Renaud, 2020).

These reasons may explain the comparatively higher odds of meeting OCD screening criteria and the lower odds of experiencing elevated depressive symptoms at the second point of measurement.

No consistent group differences based on gender, race/ethnicity, income levels, and years of study were found across the two waves of measurement. Even though more female students reported experiencing elevated depressive symptoms at Wave A, this result was not replicated at Wave B.

Overall, this study provided empirical evidence showing the adverse psychological impact of the pandemic in terms of a higher number of individuals experiencing elevated symptoms of depression, anxiety, and OCD. According to Yong and Suh (2022), specific COVID-19-related stressors, in terms of social restrictions, health concerns, future uncertainty, and resource constraints were associated with depressive and anxiety symptoms, as well as students' adjustment to university life. For university students already negotiating transitional milestones (e.g., living on their own, internship, and full-time employment), pandemic stressors are additional challenges that can have enduring consequences for life choices in areas of relationships, education, and career. For some individuals, difficulties with adjustment may increase vulnerabilities for long-term mental health problems.

Limitations

There were several limitations in this study. One main limitation was that the measures of depression and anxiety were not administered to all participants, but only subsamples of them, resulting in small sample sizes of 236-400 students for estimating prevalence of depression and anxiety in university students. However, given the homogeneity of the university student population and the good representativeness of the initial sample recruited, the probability of statistical biases associated with small samples might be reduced. Additionally, comorbidity among the three sets of symptoms could not be investigated even though OCD exhibits a high degree of comorbidity with depression and anxiety (Lochner et al., 2014). Similar concerns about small sample sizes may also apply to analyses of group differences based on race/ethnicity. There were relatively few Malay (70 at Wave A) and Indian students (83 at Wave A) in the sample.

Second, conclusions about the increase in prevalence of elevated symptoms were not based on direct comparisons between current and previous estimates since data collection for this study was initiated only after the onset of the pandemic. Third, comparisons made with prevalence estimates from overseas studies did not account for differing local epidemiological conditions due to varying infectious spread of COVID-19 and different mitigating responses.

On the other hand, this study was the first to focus on the mental health symptoms of the young adult population in Singapore during COVID-19. Information about the prevalence of mental health conditions

is important since they serve as population health indices that characterize the context under which individuals may access and use mental health services (Andersen et al., 2014). Given the increase in mental health issues, it is important that the public health response to the pandemic includes systematic prevention and intervention efforts for mental health.

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Declaration of conflict of interest

The authors declare that they have no conflict of interest.

Availability of data and material

The data that support the findings of this study will be made available by the first author upon reasonable request.

Author's contributions

Minglee Yong contributed to the following aspects of the study – conceptualization, methodology, formal analysis and investigation, writing, and funding acquisition. Carolyn Keh contributed to methodology and reviewing of the drafts.

Ethics and informed consent

Informed consent was obtained from all individual participants in the study.

Ethics Approval

This study was approved by the Institutional Review Board of the Nanyang Technological University.

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