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Depression, Anxiety and Stress Symptomatology among Swedish University Students Before and During the COVID-19 Pandemic: A Cohort Study.

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Abstract

Background. The COVID-19 pandemic has had a profound effect on societies, economies, and daily life of citizens worldwide. This has raised important concerns about the mental health of different populations. We aimed to determine if symptom levels of depression, anxiety, and stress were different during the COVID-19 outbreak compared to before, with the Depression, Anxiety and Stress Scale as main outcome. We also aimed to determine whether pre-pandemic loneliness, poor sleep quality and mental health problems were associated with worse trajectories of mental health.

Methods. We conducted a cohort study with 1658 Swedish university students answering questionnaires before the pandemic and a 81 % response-rate to follow-ups during the pandemic. Generalized Estimating Equations were used to estimate mean levels of symptoms before and during the pandemic, and to estimate effect modification by levels of loneliness, sleep quality and pre-existing mental health problems.

Results. We found small differences in symptoms. Mean depression increased by 0.23/21 (95% CI:0.03 to 0.43), mean anxiety decreased by -0.06/21 (95% CI: -0.21 to 0.09) and mean stress decreased by -0.34/21 (95% CI: -0.56 to -0.12). Loneliness, poor sleep quality and pre-existing mental health problems minimally influenced trajectories.

Conclusions. Contrary to widely held concerns, we found minimal changes in mental health among Swedish university students during the first months of the COVID-19 pandemic.

Background

The COVID-19 pandemic has had a profound impact on societies and the daily lives of citizens globally. In a recent call for action, Holmes et al. [1] raised concern about the potential detrimental effects that the pandemic might have on mental health and urgently called for research to evaluate the impact of the pandemic. With repeated reports of high levels of mental health problems among university students [2,3], it is of outmost importance to describe the impact of the pandemic on the mental health of university students.

A recent review of the literature suggests that the COVID-19 pandemic has led to increased symptoms of depression and anxiety, and that some groups might be more at risk than others [4]. However, most studies included in the review were cross-sectional and it is therefore challenging to determine how mental health status evolved in the early months of the pandemic. For university students specifically, there are some studies indicating short-term increases in depression and anxiety during COVID-19 [5,6], while others have found no changes [7]. Moreover, it is plausible that the mental health impact of the pandemic differs between regions and countries, as well as between sub-groups within populations. Most of the current research has been performed in China, and none in Sweden.

Sweden's strategy to contain the spread of the virus has received international attention both due to its lack of restrictions, and because of its comparably high mortality. Sweden reported its first case of COVID-19 on January 31st, 2020. The rapid spread of the virus in March 2020 prompted the Swedish government to implement regulations and policies to contain the spread of the virus. Like for most other countries, the public health strategy in Sweden was to promote physical distancing. Unlike many other countries, the implementation of this strategy has relied on voluntary behaviors. No lockdowns have been issued, and although reductions in social contacts, mobility and travelling has been strongly encouraged by authorities, it has not been enforced. Nevertheless, on site university-based education was cancelled on March 17, 2020 and replaced by online education.

Given Sweden's somewhat unique strategy there is an urgent need to conduct longitudinal evaluations of the mental health impact of the COVID-19 pandemic. University students, who generally show comparably high levels of mental health problems, are a potential at-risk group. With-in this group different factors might put some students at higher risk than others.

Social isolation and loneliness

A recent survey identified concerns about the impact of physical distancing and loneliness on mental health during the COVID-19 pandemic [8]. Loneliness is a predictor for the development of depression [9], and it is associated with worse prognosis for depressed individuals [10]. Recent research has found that social isolation triggers neural craving responses similar to hunger [11]. Therefore, people with pre-existing loneliness may feel even more socially deprived during the pandemic, and this may negatively impact their mental health.

Sleep quality

Poor sleep quality is a prevalent and increasing problem among university students [12]. Sleep disturbances have bidirectional etiological associations with depression, anxiety, and stress [13-16], and has shown associations with depression and anxiety during the pandemic [4]. Physiologically, poor sleep quality impairs emotional regulation and increases affective reactivity [18]. Further, poor sleep quality is associated with increased negative emotions following disruptive events [19] and a lower threshold for perceived stress and increased negative affect following mild cognitive stressors [20]. Therefore, it is important to determine whether changes in mental health in university students during the COVID-19 pandemic are modified by sleep quality.

Mental health problems

As highlighted by Yao [21], individuals with pre-existing mental health problems may be at risk of worsening symptoms during the COVID-19 pandemic. Two recent studies have reported increased symptoms of anxiety, symptoms of eating disorder and other psychiatric symptoms among psychiatric patients during the COVID-19 pandemic [4]. This may be significant also for individuals with minor mental health problems because they are at risk for developing more severe problems [22-24].

Our primary aim was to determine the mean differences in depression, anxiety, and stress symptomatology in university students in Stockholm comparing symptom levels before and during the first three months of the COVID-19 pandemic. Our secondary aim was to determine whether pre-pandemic loneliness, poor sleep quality and mental health problems were associated with different trajectories of changes in symptoms of depression, anxiety, and stress. Our hypotheses were that symptoms of depression, anxiety, and stress would worsen over the first months of the COVID-19 pandemic. We also hypothesized that the trajectories would be worse for groups of students reporting loneliness, poor sleep quality and pre-existing mental health problems.

Methods

Design and study population

We conducted a cohort study of university students in Stockholm, Sweden before and during the outbreak of the COVID-19. The study is nested within a large on-going dynamic cohort study of university students: the Sustainable University Life (SUN-study) (ClinicalTrial.gov ID: NCT04465435).

All full-time undergraduate students enrolled at Karolinska Institutet (KI), Sophiahemmet University (SHH) and The Scandinavian College of Naprapathic Manual Medicine (NPH) with at least one year left to complete their degree were eligible for inclusion in the study. We also invited all students from the architectural program at Royal Institute of Technology (KTH), students in the bachelor program Business and Economics from the Stockholm School of Economics (SCE) and targeted bachelor programs at The Swedish School of Health and Sports Sciences (GIH) to enroll in the study. Data collection started in August 2019 and is still ongoing.

Data collection

The data was collected online. Students received information about the study through in-class presentations by study staff. Students were invited to complete the baseline survey and provided with access links to the study questionnaire via e-mail. All participants provided informed consent electronically before entering the study. Information about the study was also given in relevant social media channels (e.g. student union social media channels), and through on-campus information sites. Included students were followed with web surveys every three months starting in November 2019. Participants not responding to the follow-up received reminders by email, phone text-message and one phone call over the following month. The study was approved by the Swedish Ethical Review Authority (reference number: 2019-03276, 2020-01449).

The data collected from December 1, 2019 to February 28, 2020 was used as baseline information “before pandemic” (except for the demographic variables for participants from SHH and NPH which were collected August-September 2019). Data collected from March 1 to May 20, 2020 provided follow-up information “during pandemic” (see Table 1). This categorization is based on the facts that Sweden had very few cases of COVID-19 throughout February, with an accelerating spread in March.

Table 1. Participants baseline characteristics and a comparison of the odds of being lost to follow-up between levels of characteristics.

	All participants n = 1658	Participants at follow-up n = 1354	Participants lost to follow-up N=304	Crude OR of dropping out (95 % CI)
DASS-21 Depression, mean (SD)	4.70 (4.75)	4.63 (4.67)	5.04 (5.06)	1.07 (0.81 to 1.41)
DASS-21 Anxiety, mean (SD)	3.17 (3.51)	3.14 (3.48)	3.32 (3.61)	1.12 (0.82 to 1.50)
DASS-21 Stress, mean (SD)	6.58 (4.67)	6.53 (4.62)	6.78 (4.88)	1.32 (1.0 to 1.74)
Age, mean (SD)	26.45 (6.9)	26.59 (7.01)	25.84 (6.39)	0.83 (0.64 to 1.06)
Females, n (%)	1225 (73.84 %)	1020 (75.33%)	205 (67.43)	0.68 (0.52 to 0.89)
University, n (%) KI SHH NPH SSE KTH GIH	 1064 (64.17 %) 218 (13.15 %) 136 (8.20%) 119 (7.18%) 80 (4.83%) 41 (2.47 %)	 902 (66.62 %) 175 (12.92 %) 110 (8.12%) 84 (6.10%) 52 (3.84%) 31 (2.29%)	 162 (53.29%) 43 (14.14%) 26 (8.55%) 35 (11.51%) 28 (9.21%) 10 (3.29%)	 Ref 1.37 (0.93 to 1.97) 1.32 (0.82 to 2.05) 2.32 (1.50 to 3.53) 3 (1.82 to 4.85) 1.8 (0.82 to 3.61)
Lonely, n (%)	641 (38.66 %)	518 (38.26 %)	123 (40.46%)	1.1 (0.85 to 1.41)
Moderate mental health problems, n (%)	664 (40.05 %)	541 (39.96%)	123 (40.46 %)	1.02 (0.79 to 1.31)
Poor sleep, n (%)	943 (56.88%)	773 (57.09 %)	170 (55.92)	0.95 (0.74 to 1.23)
Year of Study, n (%) 1st 2nd 3rd Masters	 623 (37.58%) 415 (25.03 %) 273 (16.47%) 347 (20.93 %)	 484 (35.75%) 339 (25.04%) 230 (16.99 %) 301 (22.23 %)	 139 (45.72%) 76 (25%) 43 (14.14%) 46 (15.13%)	 Ref 0.78 (0.57 to 1.06) 0.65 (0.44 to 0.94) 0.53 (0.37 to 0.76)
At least one parent with university education, n (%)	1189 (71.71 %)	972 (71.79 %)	217 (71.38%)	0.98 (0.75 to 1.30)
Country of Origin, n (%) Sweden Scandinavia Europe Outside Europe	 1337 (80.64%) 78 (4.70%) 85 (5.13%) 158 (9.53%)	 1098 (81.09%) 67 (4.95%) 71 (5.24%) 118 (8.71%)	 239 (78.62%) 11 (3.62%) 14 (4.61%) 40 (13.16%)	 Ref 0.75 (0.37 to 1.39) 0.91 (0.48 to 1.59) 1.56 (1.05 to 2.27)
Month of observation December January February March	 83 (5.00%) 952 (57.42%)	 .. .. .. 70 (5.17%)	..	..

April May	623 (37.58%)	997 (73.63%) 287 (21.20%)		

Karolinska Instituet (KI), Sophiahemmet University (SHH), The Scandinavian College of Naprapathic Manual Medicine (NPH), Stockholm School of Economics (SCE), Royal Institute of Technology (KTH), The Swedish School of Health and Sports Sciences (GIH). For the attrition analysis age has been dichotomized by the median value 24 years (<24 years is the reference category). DASS-21 values have been dichotomized at the level for moderate symptoms, see Methods section (below cut-off is the reference category).

Measurement of loneliness, sleep quality and pre-existing mental health problems

Loneliness was measured using the UCLA Three-Item Loneliness Scale [25] with a total score ranging from 3-9 points. In accordance with previous research, we used a cut-off of ≥ 6/9 to define loneliness [26]. UCLA Three-Item Loneliness Scale has acceptable internal consistency (Cronbach's α= 0.72) and high correlation (r=0.82) with the 20 item Revised UCLA Loneliness Scale [25].

Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI) [27]. A score of > 5/21 is used to classify poor sleep quality. This cut-off has shown a sensitivity of 89.6 % and a specificity of 86.5 % for differentiating between good and poor sleepers [28]. The PSQI has adequate internal consistency (Cronbach's α =0.82) and test-retest reliability (r=0 .82) over one month [28].

Pre-existing mental health problems were measured with the Depression, Anxiety and Stress Scale (DASS-21; see psychometrics under 'Outcomes') [29] and classified as moderate symptoms if scoring above cut-off for on any of the three subscales (≥ 7 on the depression subscale or ≥ 6 on the anxiety subscale or ≥ 10 on the stress scale) [30]. Loneliness, sleep quality and pre-existing mental health problems were all measured before the pandemic.

Outcomes

We measured symptoms of depression, anxiety, and stress with DASS-21 [29]. DASS-21 has good psychometric properties, with convergent and divergent validity distinguishing between subscales, and Cronbach's α of 0.82-0.90 for the three subscales [29]. The primary outcomes are scores of depression, anxiety, and stress, respectively. For each participant, these are measured before and during the COVID-19 pandemic.

Statistical analyses

Participants baseline characteristics are presented in Table 1 as number of participants and percentages or as means with SDs for all participants, participants completing the follow-up and participants lost to follow-up.

We used Generalized Estimating Equations (GEE) to model mental health symptoms during two time periods, before and during the pandemic. GEE models treat correlation between observations from the same individual as nuisance parameters and provide estimates of the marginal population mean of the outcome. Our data was not normally distributed, which was one reason for choosing GEE since the model do not rely on the assumption of normally distributed outcome measures or the normality of residuals. We built three separate models, one each for symptoms of depression, anxiety, and stress, to assess overall mean differences in symptoms from before to during the pandemic. These models included only time-point (before vs. during pandemic) as the predictor. Since the models evaluated differences over time for the full group, no covariates were used in these models. An exchangeable correlation matrix was specified, although with only two time points, it makes no difference which structure is used.

Subsequently nine separate models were fitted to assess if differences between the outcomes from before to during the pandemic varied by loneliness, poor sleep quality or pre-existing mental health problems. These models included an exposure variable of dichotomized loneliness, sleep quality or pre-existing mental health problems and time-point as predictors. A two-way interaction term between exposure and time point was included letting the differences over time vary by exposure level. These models were adjusted for age, female gender, and highest parental education level (for unadjusted coefficients see Online Resource 1). An exchangeable working correlation structure was used in all models.

We conducted a sensitivity analysis using the same methods described above in a sample of 496 participants followed from August-September 2019 to November 2019-January 2020 to compare the effect modification of the exposures during the pandemic to those of an earlier time period (Online Resource 2). All analyses were performed using RStudio version 1.2.5001, the packages ‘geepack’ and ‘emmeans’ were used to perform GEE analyses, and to derive estimated marginal means from the models.

Three items of the PSQI were missing (5b, 5f and 5j) for the first 333 included participants, due to initial technical problems with the web survey. We imputed these missing variables by imputing the individual mean values from observed items 5b-5j on the PSQI. No other measures had missing items.

We investigated whether loss to follow-up was random, or systematic by investigating the association between baseline characteristics and dropping out of the study by building a series of logistic regression models. We report crude odds ratios (ORs) of being lost to follow-up (Table 1).

Results

We invited 6681 students to participate and 1658 (24.8 %) consented between December 1, 2019 and February 28, 2020. Of those, 81.2 % provided follow-up data (n=1354) between March 1, and May 20, 2020 (Figure 1). At baseline, the mean age was 26.5 years, 73.8 % were female, and 80.6 % were born in Sweden (Table 1).

The attrition analysis suggests that participants with moderate-severe symptoms of stress symptoms before the pandemic were more likely to be lost to follow-up (OR 1.32, 95% CI: 1.0 to 1.74). However, we found no association between moderate-severe symptoms of depression (OR 1.07, 95% CI: 0.81 to 1.41), anxiety (OR 1.12, 95% CI: 0.82 to 1.50), loneliness (OR 1.1, 95% CI: 0.85 to 1.41), poor sleep quality (OR 0.95, 95% CI: 0.74 to 1.23) and pre-existing mental health problems (OR 1.02, 95% CI: 0.79 to 1.31) and dropping out of the study.

When comparing the symptom levels before and during the pandemic, we found a small mean increase in depressive symptoms (0.23/21, 95% CI:0.03 to 0.43), small decrease in mean anxiety symptoms (-0.06/21, 95% CI: -0.21 to 0.09) and a small decrease in mean stress symptoms (-0.34/21, 95% CI: -0.56 to -0.12) from before to during the pandemic (Table 2, Figure 2).

Table 2. Estimated marginal means with 95% CI and differences from before to during the pandemic.

	Before pandemic (Dec-Feb)	During Pandemic (March-May)	Difference, During-Before (95 % CI, p-value)
DASS-21 Depression			
Full sample	4.70 (4.47 to 4.93)	4.92 (4.70 to 5.17)	0.23 (0.03 to 0.43)
Lonely	7.17 (6.73 to 7.61)	6.96 (6.49 to 7.42)	- 0.22 (- 0.59 to 0.15)
Not Lonely	3.01 (2.75 to 3.27)	3.53 (3.25 to 3.80)	0.52 (0.29 to 0.75)
Difference-in-difference	..	..	-0.73(-1.17 to -0.30)
Poor Sleep	6.33 (5.96 to 6.70)	6.33 (5.96 to 6.71)	0.00 (-0.29 to 0.29)
Good sleep	2.42 (2.17 to 2.67)	2.95 (2.66 to 3.24)	0.53 (0.27 to 0.79)
Difference- in-difference	..	..	-0.53 (-0.92 to -0.13)
PEMHP	8.83 (8.43 to 9.23)	7.72(7.27 to 8.17)	-1.11 (-1.50 to -0.72)
NO-PEMHP	1.97 (1.82 to 2.13)	3.09 (2.86 to 3.33)	1.12 (0.92 to 1.32)
Difference- in-difference	..	..	-2.23 (-2.67 to -1.79)
DASS-21 Anxiety			
Full sample	3.17 (3.01 to 3.34)	3.11 (2.93 to 3.30)	- 0.06 (-0.21 to 0.09)
Lonely	4.41 (4.09 to 4.72)	4.00 (3.65 to 4.34)	-0.41 (-0.69 to -0.13)
Not Lonely	2.05 (1.85 to 2.24)	2.20 (1.98 to 2.42)	0.15 (-0.02 to 0.32)
Difference-in-difference	..	..	-0.56 (-0.90 to -0.23)
Poor Sleep	4.05 (3.78 to 4.31)	3.81 (3.54 to 4.09)	-0.23 (-0.46 to -0.00)
Good sleep	1.56 (1.36 to 1.76)	1.71 (1.48 to 1.95)	0.15 (-0.04 to 0.34)
Difference- in-difference	..	..	-0.38 (-0.68 to -0.09)
PEMHP	5.75 (5.44 to 6.06)	4.87 (4.53 to 5.22)	-0.87 (-1.17 to -0.57)
NO-PEMHP	1.21 (1.09 to 1.33)	1.68 (1.50 to 1.86)	0.47 (0.32 to 0.62)
Difference- in-difference	..	..	-1.35 (-1.68 to -1.01)
DASS-21 Stress			
Full sample	6.58 (6.35 to 6.80)	6.24 (5.99 to 6.48)	- 0.34 (-0.56 to -0.12)
Lonely	8.17 (7.79 to 8.56)	7.32 (6.88 to 7.75)	- 0.86 (-1.24 to -0.48)
Not Lonely	4.89 (4.60 to 5.18)	4.86 (4.55 to 5.17)	-0.03 (-0.29 to 0.23)
Difference-in-difference	..	..	-0.83 (-1.28 to -0.37)
Poor Sleep	7.83 (7.51 to 8.16)	7.22 (6.88 to 7.57)	-0.61 (-0.91 to – 0.31)
Good sleep	4.02 (3.72 to 4.31)	4.00 (3.66 to 4.34)	-0.02 (-0.42 to 0.38)
Difference- in-difference	..	..	-0.60 (-1.02 to -0.17)
PEMHP	10.27 (9.94 to 10.6)	8.53 (8.13 to 8.93)	-1.75(-2.14 to -1.36)
NO-PEMHP	3.58 (3.39 to 3.77)	4.15 (3.88 to 4.42)	0.57 (0.36 to 0.81)
Difference- in-difference	..	..	-2.32 (-2.77 to -1.86)

Pre-existing mental health problems (PEMHP). All models are adjusted for age (interval), highest parental education (university vs. all others) and female gender. Difference-in-difference is calculated as change in exposed – change in unexposed with a 95% CI.

Students reporting being lonely at baseline showed a mean decrease in depressive symptoms (-0.22/21, 95 % CI: - 0.59 to 0.15), while those who were not lonely had a mean increase (0.52/21, 95% CI: 0.29 to 0.75). Anxiety symptoms decreased for the group reporting loneliness (-0.41/21, 95% CI: -0.69 to -0.13), and a increased marginally for those who were not lonely at baseline (0.15/21, 95% CI: -0.02 to 0.32). Stress symptoms decreased for the group exposed to loneliness (-0.86/21, 95% CI: -1.24 to -0.48), with a smaller decrease for those without loneliness (-0.03/21, 95% CI: -0.29 to 0.23). Loneliness modified the difference over time. The lonely group showed comparably favorable trajectories for depression (-0.73,

95% CI: -1.17 to -0.30), anxiety (-0.56, 95% CI: -0.90 to -0.23) as well as stress symptoms (-0.83, 95% CI: -1.28 to -0.37) compared to those not lonely (Figure 3, Table 2).

Depression symptoms for the group with poor sleep quality showed no mean difference (0.00/21, 95% CI: -0.29 to 0.29) from before to during the pandemic, while there was a mean increase for those with good sleep (0.53/21, 95% CI: 0.27 to 0.79). Anxiety symptoms showed a mean decrease over time for those with poor sleep quality (-0.23/21, 95%CI: -0.46 to -0.00) and an increase for those with good sleep quality (0.15/21, 95% CI: -0.04 to 0.34). Stress symptoms decreased for the group with poor sleep quality (-0.61/21, 95% CI: -0.91 to -0.31), with a smaller decrease for the group with good sleep quality (-0.02/21, 95% CI: -0.42 to 0.38). Sleep quality modified the difference over time, with those with poor sleep quality decreasing over time regarding depression (-0.53, 95% CI: -0.92 to -0.13), anxiety (-0.3, 95% CI: -0.68 to -0.09) and stress (-0.60, 95% CI: -1.02 to -0.17) compared to the group with good sleep (Figure 3, Table 2).

The group with mental health problems at baseline showed decreasing mean level of symptoms for depression (-1.11/21, 95% CI: -1.50 to -0.72), anxiety (-0.87/21, 95% CI: -1.17 to -0.57) and stress (-1.75/21, 95%CI: -2.14 to -1.36) over the first months of the pandemic. The unexposed group showed the opposite pattern with increasing mean level of symptoms for depression (1.12/21, 95% CI: 0.92 to 1.32), anxiety (0.47/21, 95% CI: 0.32 to 0.62) and stress (0.57/21, 95%CI: 0.36 to 0.81) over time. Pre-existing mental health problems modified the differences over time with decreases in mean scores for the exposed group and increases for the unexposed groups. The difference between the exposed and the unexposed group over time was -2.23 (-2.67 to -1.79) points for depression, -1.35 (-1.68 to -1.01) points for anxiety, and -2.32 (-2.77 to -1.86) for points stress symptoms (Figure 3, Table 2).

Discussion

We investigated differences in symptoms of depression, anxiety, and stress in Swedish university students from before to during the first few months of the outbreak of COVID-19. The results indicate that differences in mean levels of depression, anxiety, and stress were minimal for all the comparisons. We found a small increase in depressive symptoms and small decreases in anxiety and stress symptoms. However, the differences are so small that the clinical significance of these results is debatable. Overall, our results suggest that there were no clinically meaningful mean differences in mental health in our sample of Swedish university students during the first months of the COVID-19 pandemic compared to before the pandemic.

Contrary to our hypotheses, students who were lonely, had poor sleep quality or pre-existing mental health problems before the pandemic did not show a worse trajectory of symptoms over the first months of the pandemic. We found that there were small difference-in-differences over time for all these groups when comparing to students without these characteristics. The small differences that we found were all in the opposite directions from what we had hypothesized. The groups with loneliness, poor sleep quality, and

pre-existing mental health problems all showed more favorable trajectories of mean depression, anxiety, and stress scores during the first months of the pandemic, compared those the unexposed groups.

Our study has strengths. First, we were able to conduct a natural experiment by investigating the differences in mental health symptoms before and after the pandemic reached Sweden, unlike most previous studies with similar aims [4]. Second, our follow-up rate was high (81.2 %). Attrition analyses suggests that those lost to follow-up had minimal impact on our results. Third, the instruments used for measurements of all variables have good psychometric properties, limiting the risk of misclassification. Finally, we included a large sample of university students from six universities.

We recruited 24.8 % of eligible students. Therefore, there is a possibility that selection bias influenced our results. However, the baseline pre-pandemic levels of mental health symptoms measured in our cohort were similar to those reported in previous studies of Swedish university students using the same Instrument (DASS-21) [31]. This suggests that our sample is representative of the mental health status of Swedish university students before the pandemic.

Overall, our results suggest that symptoms of depression, anxiety and stress among Swedish university students changed minimally in the first months of the COVID-19 pandemic compared to the pre-pandemic period. Our hypothesis that those who experienced loneliness, poor sleep quality and pre-existing mental health problems before the pandemic would experience worse changes in symptoms of depression, anxiety and stress was not supported by our data. For the group with pre-existing mental health problems this can be explained by regression to the mean. A similar pattern can be seen among students followed during the fall of 2019, before the pandemic (Online Resource 2). Our interpretation is that this group did not have worse trajectories during the pandemic but, as would be expected from regression to the mean, experienced decreased symptoms. The favorable trajectories for individuals who were lonely or had poor sleep quality during the pandemic cannot, however, be explained by regression to the mean. The participants followed during the fall of 2019 had more parallel trajectories, showing no or smaller difference in trajectories between exposed and unexposed (Online Resource 2). Although the clinical relevance of these small differences over time is debatable, one might speculate about the underlying mechanisms for these patterns. The fact that lonely individuals had a more favorable trajectory during the first months of the pandemic might be related to the subjective and relative aspects of experiencing loneliness. The pandemic has arguably led to more restricted social lives for most people. This might lessen the contrast when comparing one's own social life to that of others, making the experience of loneliness somewhat less emotionally painful. Our results dovetails with a recent American study, showing increases in perceived social support and no mean changes in loneliness during the first months of the COVID-19 pandemic [32]. The more favorable trajectory of those with poor sleep quality, might be explained by changes in day-to-day life brought about by the COVID-19 pandemic that makes poor sleep quality easier to deal with. Students studying from home might have less stressors during the day, perhaps decreasing the negative impact of poor sleep quality on mental health.

Our results, showing minimal differences in depression, anxiety and stress, contrasts against much of the previous research into the mental health effects of the COVID-19 pandemic. A systematic review of the literature showed that most evidence points to higher levels of depression and anxiety in the general public during the pandemic than before the pandemic, and has indicated that pre-existing mental health problems and poor sleep quality might be risk factors for depression and anxiety during the pandemic [4]. One explanation for the differences of our results to those of many previous studies are the differences in design between the studies. While we used a longitudinal design, most other previous studies were cross-sectional. Another explanation for the contrast between our results and those of many previous studies might be differences in the impact of COVID-19 on different study populations, and that the time of exposure may differ between the populations. It is possible that people in different countries has been affected differently. One reason might be that the spread of the virus has been more severe in some places than others. However, our study was performed in Stockholm, which has had comparatively high mortality. Yet another reason may be that different governmental strategies to contain the spread might have had differing impacts on mental health. Sweden's strategy, which has been less restrictive than many other countries, may have had less detrimental effects on mental health. More high-quality research is needed to compare mental health changes between populations during the COVID-19 pandemic.

Conclusions

In conclusion, contrary to previously expressed concerns, we saw only minimal differences in mental health among Swedish university students when comparing symptom levels before and during the first months of the COVID-19 pandemic. We also did not see meaningful differences in mental health for students exposed to loneliness, poor sleep quality and pre-existing mental health problems.

Abbreviations

DASS-21: Depression, Anxiety and Stress Scale 21 item version

GEE: General Estimating Equation

GIH: The Swedish School of Health and Sports Sciences

KI: Karolinska Institutet

KTH: Royal Institute of Technology

NPH: The Scandinavian College of Naprapathic Manual Medicine

OR: Odds Ratio

PEMPH: Pre-existing mental health problems

PSQI: Pittsburg Sleep Quality Inventory

SCE: Stockholm School of Economics

SHH: Sophiahemmet University

Declarations

Ethics approval and consent to participate

The study was approved by the Swedish Ethical Review Authority (reference number: 2019-03276, 2020-01449). All participants provided informed consent electronically before entering the study.

Consent for publication

In the informed consent, all participants approved that the answers they provided would be used to publish scientific research.

Availability of data and materials

The dataset generated and analyzed during the current study are not publicly available due to secondary confidentiality and privacy of the participants.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

ES was responsible for designing the study with contributions of PC, AR, IJ, MG, LWH, KE and TS. Data-collection was performed by FJ, TS, KE and ES. FJ, ES, PC and SHJ performed the statistical analyses, interpretation, and preparation of the initial manuscript. All authors provided critical revisions of the intellectual content.

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Figures

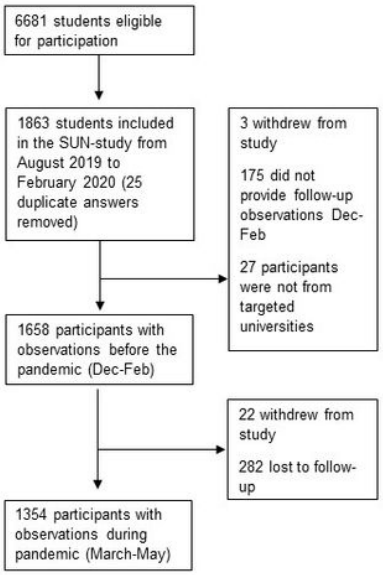

Figure 1. Flow chart. Inclusion of participants.

Figure 1

Flow chart. Inclusion of participants.

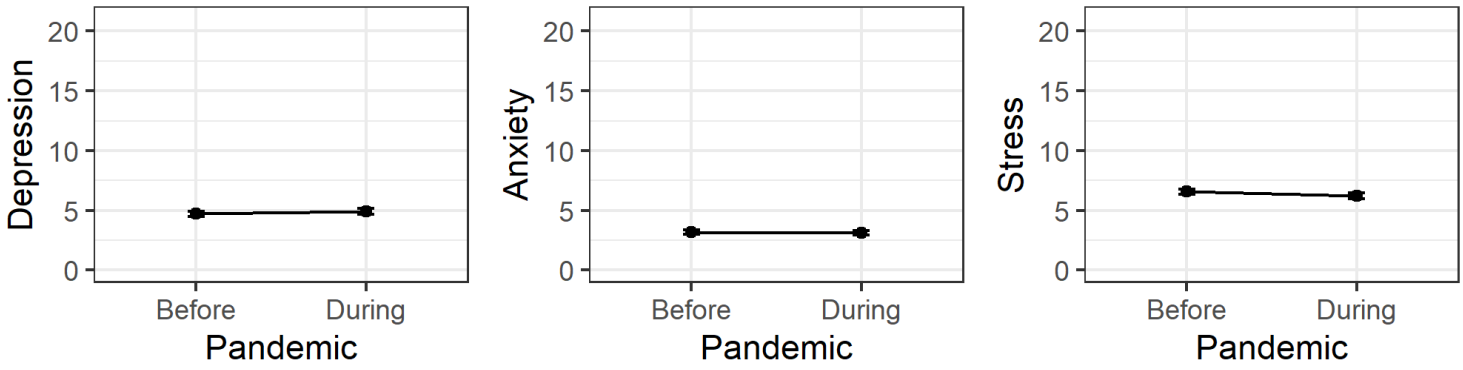

Figure 2

Differences in DASS-21 scores before and during the pandemic. Graphs of estimated means from GEE models for overall differences of DASS-21 scores before and during the COVID-19.

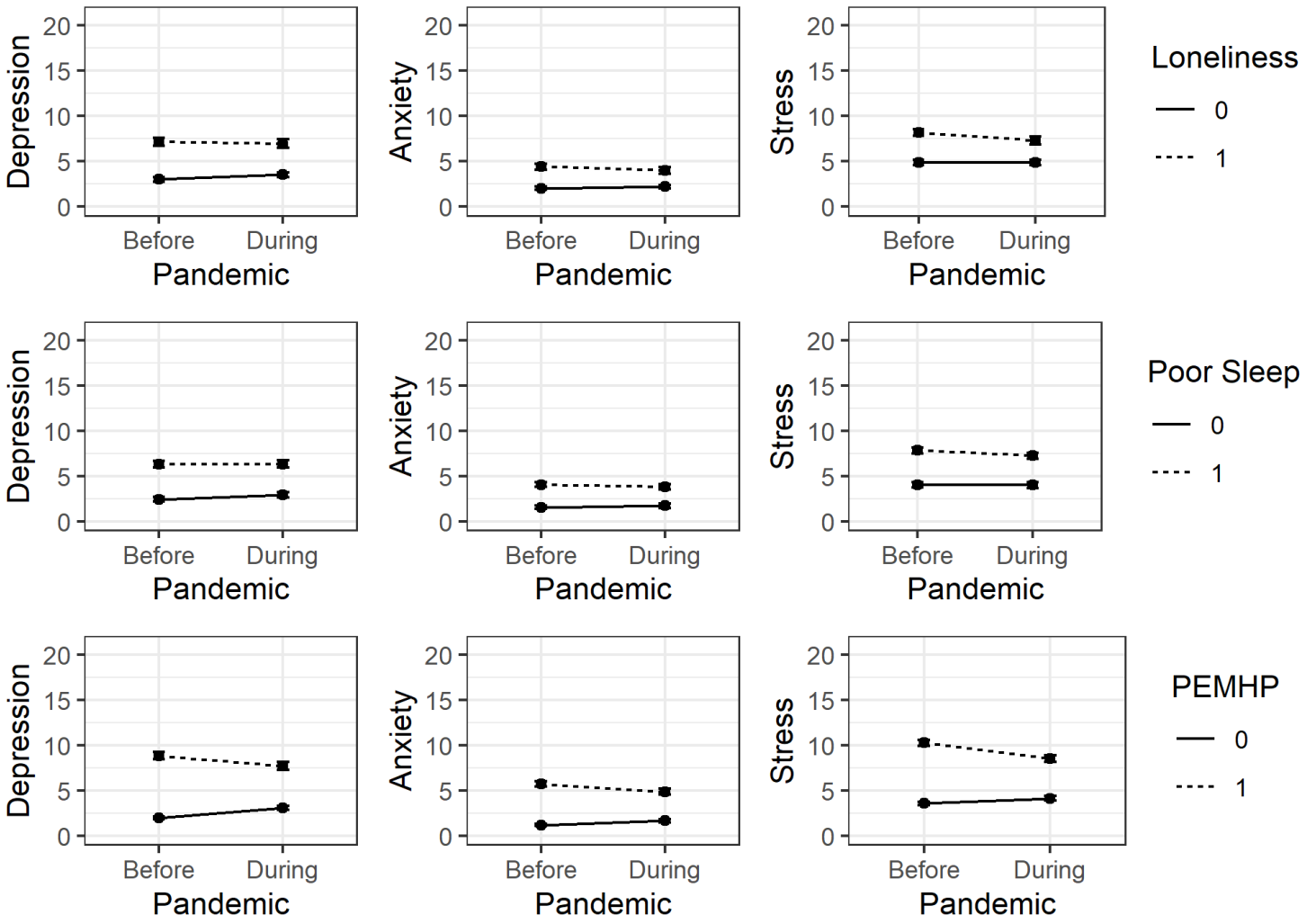

Figure 3

Differences in DASS-21 scores over time stratified by exposures. Graphs of estimated means of DASS-21 from GEE models stratified by loneliness, sleep quality and pre-existing mental health problems (PEMPH). 0 = Non exposed, 1 = Exposed.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- OnlineResource1.docx
- OnlineResource2.docx