




ORIGINAL ARTICLE

The impact of the COVID-19 pandemic on the mental health of Portuguese university students

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ABSTRACT: Worldwide, the COVID-19 pandemic has had a disruptive effect on daily routines, especially for university students. This study aimed to compare pre-pandemic domains of students' mental health during the pandemic lockdown. One cross-sectional study was conducted in two waves with academic students from 20 Portuguese universities, in March 2020 before the COVID-19 pandemic ($n = 3579$) and 2 months after the first lockdown in May 2020 ($n = 1228$). The Positive Mental Health Questionnaire (PMHQ), the Mental Health Knowledge Questionnaire, the Mental Health-promoting knowledge, and the Psychological Vulnerability Scale were used. Statistical analyses were performed by bivariate associations and multiple linear regression models. Students were mostly women (79%), with an average age of 23.2 years ($SD = 6.6$), displaced from their family environment (43%), out-of-home (43%), and scholarship holders (37%). Higher scores found in the PVS were associated with decreased PMHQ in both moments ($P < 0.01$). These cross-sectional studies showed a slight variation in the mental health variables studied in the period before and during the COVID-19 outbreak. Being a woman, younger, out-of-home, and having a scholarship ($P < 0.01$) seem to increase susceptibility to mental health variation before and during the pandemic. Universities should develop strategies that promote students' mental health.

KEY WORDS: COVID-19, literacy, positive mental health, university students, vulnerability.

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INTRODUCTION

On the 11th March, the World Health Organization (WHO 2020) declared COVID-19 a global pandemic. In 2020, over 2.2 million new cases and 39 000 deaths of COVID-19 have been reported across all six WHO regions. From the 30th of December to the 11th of October 2020, over 37 million COVID-19 cases and 1 million deaths were reported globally (WHO 2020). This outbreak (COVID-19) has initiated a worldwide crisis with dramatic consequences for health, economy, education, and society (Holmes *et al.* 2020). Several measures, including lockdown, were adopted in many countries to prevent the transmission of infection and control the rapid spread, with restrictions on movement and contact between people. While lockdown plays a critical role in promoting public health safety, it has also marked adverse effects (Brooks *et al.* 2020). These measures were extended to several national sectors, including universities that were forced to adopt safety measures to guarantee the health status of students, professors, and all staff members. Simultaneously, the COVID-19 outbreak changed habits and academic routines within a few days, imposing online academic activities (Gallego-Gómez *et al.* 2020). Therefore, distance learning has become the reality for these students. In addition to this change, many students had to return to the family home and saw their internships cancelled or adjusted to the new conditions (Brooks *et al.* 2020).

Historically, pandemics tend to increase or create new stressors such as worries, anxiety, fear of being infected or infecting loved ones, enforced constraints on physical movement, and social activities due to lockdown, consequently leading to drastic lifestyle modifications (Brooks *et al.* 2020). In a recent review, Brooks and collaborators referred to different stressors: infection fears, frustration, boredom, inadequate supplies, inadequate information, financial loss, and stigma (Brooks *et al.* 2020). Furthermore, it is also known that university students are considered a vulnerable population regarding mental health, mainly related to transitions to adulthood and the frequent economic and material difficulties of this population. As a consequence of this potential stressful context, the COVID-19 outbreak had a negative impact on students (Husky *et al.* 2020; Rubley 2017).

Different studies demonstrate a real impact of the pandemic on this population group, manifesting itself in different symptoms. The individual experience of

these young people may be associated with negative emotions, which are responsible for the onset of psychological distress (Ho *et al.* 2020). A study conducted in China involving students and addressing the influence of the pandemic on academic expectations showed that 21.3% of medical students had mild anxiety, 2.7% had moderate anxiety, and 0.9% had severe levels of anxiety. Also, having relatives or acquaintances infected with COVID-19 was a risk factor (Cao *et al.* 2020). Anxiety symptomatology was found in other studies with Chinese students (Li *et al.* 2020; Zhu *et al.* 2021). Europe is experiencing a similar scenario. Spanish studies concluded that students showed higher levels of anxiety (Alemany-Arrebola *et al.* 2020; García-González *et al.* 2021), symptomatology that is responsible for more negative emotions and low perception of academic self-efficacy (Alemany-Arrebola *et al.* 2020). Similar results were found with high rates of anxiety and moderate to severe stress levels during the confinement of university students in France (Husky *et al.* 2020). Similar to anxiety, depressive symptoms and higher levels of stress are also symptoms reported in published studies (Ahorsu *et al.* 2020; Maia & Dias, 2020).

Moreover, female students were more likely exposed to a higher risk of psychological distress during the COVID-19 pandemic and reported high levels of anxiety and depression (Anan *et al.* 2020; Aristovnik *et al.* 2020; Da Silva *et al.* 2020; Wenham *et al.* 2020; Xiong *et al.* 2020). Despite these results, recent studies highlight mental illness rather than the mental health status of college students during the pandemic. Recent evidence also shows the need to intervene as early as possible in higher education students by implementing current best practices.

Thus, this study sought to compare pre-pandemic domains of students' mental health with the levels observed during the pandemic lockdown.

METHODS

Study design and setting

A cross-sectional study was conducted in two waves with Portuguese students from 20 universities, using an online-based questionnaire on Google forms. The baseline survey was conducted in March 2020 (pre-COVID), before government-mandated sanitary lockdown, and approximately 2-month after (during-COVID), in May 2020.

Participants

The participants were students recruited through a convenience sample from a population of academic students from 20 Portuguese universities. The eligibility criteria were undergraduate students, aged over 18 years, and with internet access. On both waves, students were recruited through an email inviting them to participate, with the link to the online questionnaire. A total of 4807 students completed the questionnaire.

Variables and measurement

The dependent variables of the study were positive mental health, mental health knowledge, mental health-promoting knowledge (MHPK-10), and psychological vulnerability. The independent variables of the study were gender (male/female), age (years), out-of-home (displaced from the family home – yes/no), scholarship (students with socioeconomic needs – yes/no), and COVID phase (pre/during).

The online questionnaire was available in Portuguese and consisted of four scales (one for each dependent variable), all validated and culturally adapted, preceded by the students' sociodemographic characteristics.

Positive Mental Health Questionnaire

The Positive Mental Health Questionnaire (PMHQ) is a scale used to measure the positive mental health of adult populations (Lluch 2002, 2003; Sequeira *et al.* 2014). It consists of 39 items exploring six domains: personal satisfaction (PMHQ-PS), pro-social attitude (PMHQ-PA), self-control (PMHQ-SC), autonomy (PMHQ-AT), problem-solving and personal fulfilment (PMHQ-PP), and interpersonal skills (PMHQ-IP). Responses are rated on a 4-point Likert-type scale from 1 (*rarely/never*) to 4 (*always/almost always*), with higher scores indicating higher positive mental health levels. The Cronbach's alpha for this total scale was 0.920 (pre-COVID phase) and 0.928 (during-COVID phase).

Mental Health Knowledge Questionnaire (MHKQ)

This self-reported instrument evaluates the knowledge and awareness of mental health in the general population (Yu *et al.* 2015; Chaves, 2020). The Portuguese version (Chaves, 2020) consists of 14 items, scored on a five-point Likert scale: 1 (*strongly disagree*) to 5 (*totally agree*), each corresponding to two domains: the first domain relates to knowledge of the characteristics

of mental health and mental illnesses (MHKQ-KC), and belief in the epidemiology of mental illnesses (MHKQ-BE). One-third domain comprehends the awareness of mental health promotion activities (MHKQ-AW), using a diatomic scale: 0 (No) 1 (Yes). Each of the domains was transformed from a 0–100 scale. In MHKQ-BE lower values reveal more favourable beliefs. The Cronbach's alpha obtained at the pre-COVID phase was 0.674 for MHKQ-KC and 0.674 for MHKQ-BE, and for the during-COVID phase, it was 0.669 and 0.553, respectively. For the domain MHKQ-AW, the KR-20 was used to measure reliability, reaching values of 0.595 at the pre-COVID phase and 0.537 for the during-COVID phase.

Mental Health-promoting knowledge

The MHPK-10 is a one-dimensional scale that assesses knowledge about maintaining good mental health using 10 items (Bjørnsen *et al.* 2017; Chaves *et al.*, 2020). They are scored on a five-point Likert scale: 1 (*completely wrong*) to 5 (*completely correct*). Higher scores indicate higher levels of good mental health. The Cronbach's alpha for this scale was 0.775 (pre-COVID phase) and 0.781 (during-COVID phase).

Psychological Vulnerability Scale

This 6-item tool is used to measure psychological vulnerability, which involves maladaptive cognitive patterns, such as dependence, perfectionism, need for external sources of approval, and generalized negative attributions (Nogueira *et al.* 2017; SinClair & Wallston, 1999). It is scored on a five-point Likert scale from 1 (*does not describe me at all*) to 5 (*describes me very well*). Higher scores indicate greater psychological vulnerability. The Cronbach's alpha for this scale was 0.902 (pre-COVID phase) and 0.897 (during-COVID phase).

Statistical methods

Preliminary analyses were performed to identify missing values within each measured construct. Eight participants were excluded since they did not accomplish the established rule for a maximum of 10% of missing values on each scale. The mean imputation was performed. The dimensions were computed and described using the mean, standard deviation, and minimum and maximum values. Cronbach's alphas were based on standardized items and were calculated for the obtained dimensions to assess internal consistency. Then, bivariate associations between the different dimensions for the two different moments were

assessed using the Pearson correlation coefficient. Multiple linear regression models were performed to explore whether gender, age, out-of-home, scholarship, and phase (independent variables) could predict each of the explored 11 domains (from four dependent variables). All assumptions for using the model were previously verified. Data analyses were performed using IBM SPSS Statistics Version 26 (IBM Corp., United States), and results were considered significant for $P < 0.05$.

Ethical approval

Before data collection, ethical approval was obtained from *Escola Superior de Enfermagem do Porto* (CE-ESEP – Fluxo 2019_1945). All students were informed about the study in the introductory section of the surveys, and consent to participate was implicit. Throughout the data collection and analysis process, the anonymity of the participants was guaranteed.

RESULTS

Participants

According to Table 1, we received full responses from 3579 respondents in March (pre-COVID) and 1228 respondents in May (during-COVID), from 20 Portuguese university students. The students had an average age of 23.2 years (SD = 6.6), mostly women (79%), displaced from their family home, out-of-home (43%), and scholarship holders (37%). The distribution of the sociodemographic characteristics of the two waves was very similar.

TABLE 1 Descriptive statistics for socio-demographic characteristics of students

	Pre-COVID n (%)	During-COVID n (%)	Total n (%)
Participants	3579 (74)	1228 (26)	4807 (100)
Gender			
Female	2861 (79)	996 (81)	3857 (79)
Male	768 (21)	232 (19)	1000 (21)
Out-of-home			
No	2085 (57)	699 (57)	2784 (57)
Yes	1545 (43)	529 (43)	2074 (43)
Scholarship			
No	2238 (63)	775 (63)	3013 (63)
Yes	1341 (37)	453 (37)	1794 (37)
Age (mean ± SD)	23.2 ± 6.7	23.2 ± 6.4	23.2 ± 6.6

Global scales

Descriptive statistics for all domains of mental health variables, pre- and during-COVID, are displayed in Table 2. Regarding the PMHQ, the different domains' average scores showed low variation between phases. The pro-social attitude domain PMHQ-SC showed a higher average value in the pre- and during-COVID phases, 3.57 (SD = 0.38) and 3.6 (SD = 0.37), respectively. The lowest scores were found in the self-control domain, with 2.78 (SD = 0.64) for the pre-COVID phase, and 2.79 (SD = 0.64) for the during-COVID phase. The average for the total scale was 3.17 (SD = 0.40) at the pre-COVID phase and 3.19 (SD = 0.4) for the during-COVID phase, indicating positive mental health of the university students under study. To assess the internal consistency of the different domains of the PMHQ, a Cronbach's alpha was calculated, which varied between 0.563 and 0.864 in the pre-COVID phase, and between 0.589 and 0.878 in the during-COVID phase.

Concerning the MHKQ, there was also a slight variation between the two phases, with the mean value being higher in the knowledge domain of the characteristics of mental health and mental illnesses, 83.80 (SD = 13.78) in the pre-COVID phase and 84.35 (SD = 13.10) for the during-COVID phase. The lowest mean values were in the domain belief in the epidemiology of mental illnesses, 21.69 (SD = 16.58) in the pre-COVID phase and 20.13 (SD = 15.21) for the during-COVID phase.

The results of the MHPK-10 indicated a good knowledge about maintaining students' good mental health in the two studied phases, with average values of 4.57 (SD = 0.54) and 4.58 (SD = 0.56), respectively.

The results showed a moderate psychological vulnerability in students, with average values of 2.87 (SD = 0.88) in the pre-COVID phase and 2.84 (SD = 0.88) for the during-COVID phase.

Comparison of pre- vs during-COVID different domains of student's mental health

Table 3 shows the correlation between the different domains of students' mental health under study. Correlations between pre- and during-COVID ratings of PMHQ domains were statistically significant, with weak to moderate positive correlations in both phases. In the pre-COVID phase, the lowest correlation was found between autonomy PMHQ-AT and pro-social attitude PMHQ-PA domains ($r = 0.197$; $P < 0.01$), while the

TABLE 2 Descriptive statistics for all domains of mental health variables

Domains	Phase									
	Pre-COVID					During-COVID				
	Min	Max	M	SD	Alpha	Min	Max	M	SD	Alpha
PMHQ-PS	1	4	3.22	0.60	0.864	1	4	3.23	0.60	0.878
PMHQ-PA	1	4	3.57	0.38	0.563	1	4	3.60	0.37	0.589
PMHQ-SC	1	4	2.78	0.64	0.823	1	4	2.79	0.64	0.846
PMHQ-AT	1	4	3.10	0.59	0.758	1	4	3.08	0.60	0.783
PMHQ-PP	1	4	3.15	0.49	0.821	1	4	3.19	0.49	0.828
PMHQ-IP	1	4	3.19	0.49	0.701	1	4	3.21	0.48	0.726
PMHQ-TT	2	4	3.17	0.40	0.920	1	4	3.19	0.40	0.928
MHKQ-KC	0	100	83.80	13.78	0.674	0	100	84.35	13.10	0.669
MHKQ-BE	0	100	21.69	16.58	0.608	0	100	20.13	15.21	0.553
MHKQ-AW	0	100	60.07	31.24	0.595 [†]	0	100	60.66	29.82	0.537 [†]
MHPK-10	1	5	4.57	0.54	0.775	1	5	4.58	0.56	0.781
PVS	1	5	2.87	0.88	0.902	1	5	2.84	0.88	0.897

Abbreviations: MHKQ-AW, Mental Health Knowledge Questionnaire-Awareness of Mental Health Promotion Activities; MHKQ-BE, Mental Health Knowledge Questionnaire-Belief in the Epidemiology of Mental illnesses; MHKQ-KC, Mental Health Knowledge Questionnaire-Knowledge of the Characteristics of Mental Health and Mental illnesses; MHKQ-TT, Mental Health Knowledge Questionnaire-Total; MHPK-10, Mental Health-promoting Knowledge; PMHQ-AT, Positive Mental Health Questionnaire-Autonomy; PMHQ-IP, Positive Mental Health Questionnaire-Interpersonal Skills; PMHQ-PA, Positive Mental Health Questionnaire-Pro-social Attitude; PMHQ-PP, Positive Mental Health Questionnaire-Problem Solving and Personal Fulfilment; PMHQ-PS, Positive Mental Health Questionnaire-Personal Satisfaction; PMHQ-SC, Positive Mental Health Questionnaire-self-control; PMHQ-TT, Positive Mental Health Questionnaire-Total; PVS, Psychological Vulnerability Scale.

[†]Used KR-20 instead of Cronbach Alpha.

strongest was between problem-solving and personal fulfilment PMHQ-PP and self-control PMHQ-SC domains ($r = 0.605$; $P < 0.01$). Concerning the during-COVID phase, the weakest correlation remained in the same domains as the pre-COVID phase, with the strongest correlation observed between the self-control PMHQ-SC and personal satisfaction PMHQ-PS domains ($r = 0.620$; $P < 0.01$).

Firmer belief in the epidemiology of mental illnesses assessed by the MHKQ-BE was weakly related to a decrease in pro-social attitude PMHQ-PA domains in pre ($r = -0.193$, $P < 0.01$) and during-COVID ($r = -0.218$, $P < 0.01$) phases.

The students with higher levels of mental health-promoting knowledge MHPK-10 reported higher levels of knowledge of the characteristics of mental health and mental illnesses MHKQ-KC. This correlation was stronger in the pre-COVID phase ($r = 0.408$, $P < 0.01$) than in the during-COVID phase ($r = 0.280$, $P < 0.01$).

Higher psychological vulnerability in students, measured by the PVS, was associated with a statistically significant decrease of all domains of positive mental health PMHQ in both phases ($P < 0.01$). These correlations were more robust in all domains in the during-COVID phase, ranging from $r = -0.190$ in the pro-

social attitude domain to $r = -0.659$ in the personal satisfaction domain.

Explanatory model of the different domains of student's mental health

Tables 4 and 5 show multiple linear regression models performed to explore different students' characteristics and phases that could predict each of the 11 mental health domains.

Students' gender was a predictor of almost all variables, except for the PMHQ-PP. Women showed significantly lower scores than men on the PMHQ-PS ($\beta = -0.038$, $P < 0.001$), PMHQ-SC ($\beta = -0.176$, $P < 0.001$), PMHQ-AT ($\beta = -0.068$, $P < 0.001$) and MHKQ-BE ($\beta = -0.170$, $P < 0.001$); and higher significant scores in the domains PMHQ-PA ($\beta = 0.130$, $P < 0.001$), PMHQ-IP ($\beta = 0.069$, $P < 0.001$), MHKQ-KC ($\beta = 0.139$, $P < 0.001$), MHKQ-AW ($\beta = 0.128$, $P < 0.001$), MHPK-10 ($\beta = 0.127$, $P < 0.001$), and PVS ($\beta = 0.109$, $P < 0.001$).

For the variable 'age', younger students showed significantly higher scores than older students in the PMHQ-PA ($\beta = -0.036$, $P < 0.05$) and PVS ($\beta = -0.169$, $P < 0.001$) domains. On the other hand,

TABLE 3 Correlations between pre- and during-COVID ratings of the different domains of students' mental health

Phase		PMHQ-PS	PMHQ-PA	PMHQ-SC	PMHQ-AT	PMHQ-PP	PMHQ-IP	MHKQ-KC	MHKQ-BE	MHKQ-AW	MHPK-10
Pre-COVID	PMHQ-PA	0.231**									
	PMHQ-SC	0.581**	0.243**								
	PMHQ-AT	0.595**	0.197**	0.456**							
	PMHQ-PP	0.540**	0.424**	0.605**	0.451**						
	PMHQ-IP	0.448**	0.506**	0.365**	0.353**	0.499**					
	MHKQ-KC	0.045**	0.184**	0.004	0.003	0.133**	0.138**				
	MHKQ-BE	-0.023	-0.193**	-0.002	-0.018	-0.097**	-0.100**	-0.401**			
	MHKQ-AW	0.095**	0.140**	0.075**	0.086**	0.142**	0.156**	0.102**	-0.071**		
	MHPK-10	0.094**	0.186**	0.064**	0.063**	0.193**	0.170**	0.408**	-0.260**	0.100**	
	PVS	-0.630**	-0.129**	-0.549**	-0.552**	-0.455**	-0.296**	0.039†	-0.017	-0.060**	-0.026
During-COVID	PMHQ-PA	0.278**									
	PMHQ-SC	0.620**	0.253**								
	PMHQ-AT	0.594**	0.200**	0.485**							
	PMHQ-PP	0.569**	0.477**	0.615**	0.474**						
	PMHQ-IP	0.485**	0.498**	0.363**	0.369**	0.518**					
	MHKQ-KC	0.076**	0.224**	0.041	0.043	0.195**	0.224**				
	MHKQ-BE	-0.062*	-0.218**	-0.032	-0.042	-0.166**	-0.146**	-0.393**			
	MHKQ-AW	0.063*	0.141**	0.091**	0.084**	0.121**	0.129**	0.037	-0.077**		
	MHPK-10	0.067*	0.146**	0.001	0.020	0.123**	0.172**	0.280**	-0.122**	0.092**	
	PVS	-0.659**	-0.190**	-0.622**	-0.598**	-0.488**	-0.343**	0.046	0.010	-0.061*	0.000

* $P < 0.05$; ** $P < 0.01$

Abbreviations: MHKQ-AW, Mental Health Knowledge Questionnaire-Awareness of Mental Health Promotion Activities; MHKQ-BE, Mental Health Knowledge Questionnaire-Belief in the Epidemiology of Mental illnesses; MHKQ-KC, Mental Health Knowledge Questionnaire-Knowledge of the Characteristics of Mental Health and Mental illnesses; MHKQ-TT, Mental Health Knowledge Questionnaire-Total; MHPK-10, Mental Health-promoting Knowledge; PMHQ-AT, Positive Mental Health Questionnaire-Autonomy; PMHQ-IP, Positive Mental Health Questionnaire-Interpersonal Skills; PMHQ-PA, Positive Mental Health Questionnaire-Pro-social Attitude; PMHQ-PP, Positive Mental Health Questionnaire-Problem Solving and Personal Fulfilment; PMHQ-PS, Positive Mental Health Questionnaire-Personal Satisfaction; PMHQ-SC, Positive Mental Health Questionnaire-self-control; PVS, Psychological Vulnerability Scale.

older students showed significantly higher values in the domains PMHQ-PS ($\beta = 0.121, P < 0.001$), PMHQ-SC ($\beta = 0.139, P < 0.001$), PMHQ-AT ($\beta = 0.142, P < 0.001$), PMHQ-PP ($\beta = 0.135, P < 0.001$), PMHQ-IP ($\beta = 0.084, P < 0.001$), MHKQ-AW ($\beta = 0.083, P < 0.001$), and MHPK-10 ($\beta = 0.032, P < 0.05$).

Of the 11 variables tested in the model, the variable 'out-of-home' showed significant differences in five of these variables. Students displaced from their family environment registered significantly lower values of PMHQ-IP ($\beta = -0.045, P < 0.01$), MHKQ-KC ($\beta = -0.044, P < 0.01$), PMHQ-SC ($\beta = -0.031, P < 0.05$), and MHKQ-AW ($\beta = -0.036, P < 0.01$); and higher values of MHKQ-BE ($\beta = 0.113, P < 0.001$).

The variable 'scholarship' demonstrated to only contribute to the MHKQ-AW and PVS, where students who had a scholarship had significantly higher values in the MHKQ-AW domain ($\beta = 0.04, P < 0.01$) and lower values in the PVS ($\beta = -0.034, P < 0.05$).

The 'phase' contributed to three of the eleven variables in the regression model. In the during-COVID phase, students scored significantly lower values in the MHKQ-BE domain ($\beta = -0.04, P < 0.01$) and higher in the PMHQ-PA ($\beta = 0.029, P < 0.05$) and PMHQ-PP ($\beta = 0.036, P < 0.05$) domains.

DISCUSSION

Our results report a considerable sample of 4807 students from 20 Portuguese universities from different regions and undergraduate courses. The students involved in this study had, on average, 23.2 (SD = 6.6) years old, mostly women (79%), more than half (57.0%) lived in the family house, not being 'Out-of-home', and 63% did not receive a scholarship based on socioeconomic needs. Our results corroborate those of other studies conducted on students' mental health in different populations during COVID pandemics (Aristovnik *et al.* 2020; Browning *et al.* 2021; Cao *et al.* 2020).

This study sought to compare domains of students' mental health of Portuguese university students before and during the first wave of the COVID-19 pandemic and lockdown.

These study results indicated very low variation in global scores for all scales, before and during the COVID-19 pandemic (Tables 2 and 3). As we can see through our results, the total mean of Positive Mental Health score remained similar between phases, being 3.17 (SD = 0.40) in the pre-covid phase and 3.19 (SD = 0.40) during-covid with equal minimums and maximums. The values were high (maximum 4) leading us to reflect that positive mental health is something basal, presenting no changes in such a short period of time – 2 months. Until proven otherwise, these results are innovative in the use of this variable (positive mental health) during the COVID pandemic. On the other hand, it becomes difficult to compare our results with other studies. However, when comparing with a study that used the PMHQ in a Portuguese and Spanish students' sample, we verified that levels of positive mental health were high (Sequeira *et al.* 2020), corroborating our study results.

Concerning knowledge of mental health, results showed a small variation between the two phases, pre- and during-covid, in three domains: MHKQ-KC, MHKQ-BE, and MHKQ-AW. Similar to the results on positive mental health, these results showed that this variable remained unchanged during the evaluated phase of the pandemic. These results suggest that knowledge about mental health has remained solid without being affected by the COVID-19 pandemic. A study that used this same scale in university students in the pre-pandemic period (Cunha 2020) revealed rather similar results. In the domain of knowledge of the characteristics of mental health and mental illnesses a score of 83.80 was obtained while the other study reached 84.2; in the domain of belief in the epidemiology of mental illnesses these study results showed slightly lower values than the reported study (21.69 vs 34.90) revealing more favourable beliefs; regarding the awareness of mental health promotion activities, our study shows 60.07 and the other reports 69.00.

Concerning the variable MHPK-10 our results are similar in the two phases showing an average of 4.57 (pre-covid) and 4.58 (during-covid), suggesting students' high knowledge on maintaining good mental health. These results are in line with those of the previous variables, confirming the weak variation between phases.

Regarding psychological vulnerability, students who were more psychologically vulnerable showed lower positive mental health ($-0.129 < r < -0.630$), and this correlation was stronger in the during-COVID-19 phase ($-0.190 < r < -0.659$). These results seem to be in line with other studies that explored the vulnerability of students during the COVID-19 pandemic (Vigouroux *et al.* 2021).

This study showed gender differences in academic students. In particular, women were more likely to show low positive mental health in four domains: personal satisfaction ($\beta = -0.038$, $P < 0.001$), self-control ($\beta = -0.176$, $P < 0.001$), autonomy ($\beta = -0.068$, $P < 0.001$), and belief in the epidemiology of mental illnesses ($\beta = -0.170$, $P < 0.001$) compared to men. Moreover, women reported changes and higher levels in other domains compared to men: positive mental health pro-social attitude ($\beta = 0.130$, $P < 0.001$), positive mental health – interpersonal skills ($\beta = 0.069$, $P < 0.001$), mental health knowledge – knowledge of the characteristics of mental health and mental illnesses ($\beta = 0.139$, $P < 0.001$), mental health knowledge-awareness of mental health promotion activities ($\beta = 0.128$, $P < 0.001$), MHPK-10 ($\beta = 0.127$, $P < 0.001$), and PVS ($\beta = 0.109$, $P < 0.001$). A recent study suggests that female students seem to reveal a worsening of mental health status due to psychological distress experienced during the COVID-19 pandemic (Browning *et al.* 2021). This might be explained by the increasing worries about family and friends, concerns regarding their future career, and less interaction and support from the personal network (Browning *et al.* 2021). Furthermore, other studies noticed that female students are more likely to become more depressed, anxious, stressed, and lonely (Anan *et al.* 2020; Aylie *et al.* 2020; Elmer *et al.* 2020). A study conducted by Bernhardsdóttir and Vilhjálmsón (2013) reported that levels of psychological distress in female students were similar compared to the overall female population. Nevertheless, the same study indicated lower depression levels than the overall population of women with the same age and other characteristics.

Some very recent studies involving academic students recognized women as being at a higher risk of psychological distress during the COVID-19 pandemic (Anan *et al.* 2020; Aristovnik *et al.* 2020; Da Silva *et al.* 2020; Wenham *et al.* 2020; Xiong *et al.* 2020). Women seem to be more keen and vulnerable to some disorders, including anxiety and depression (Hunt & Eisenberg, 2010). Evidence from Browning and collaborators

TABLE 4 Multiple linear regression of Positive Mental Health Questionnaire domains

	PMHQ-PS			PMHQ-PA			PMHQ-SC			PMHQ-AT			PMHQ-PP			PMHQ-IP								
	95% CI B			95% CI B			95% CI B			95% CI B			95% CI B			95% CI B								
	B	LB	UB	B	LB	UB	B	LB	UB	B	LB	UB	B	LB	UB	B	LB	UB	Beta					
Gender (0 male)	-0.056	-0.088	-0.014	-0.038**	0.121	0.095	0.147	0.130***	-0.276	-0.320	-0.233	-0.176***	-0.099	-0.140	-0.058	-0.068***	-0.007	-0.042	0.027	-0.006	0.083	0.049	0.117	0.069***
Age	0.011	0.008	0.014	0.121***	-0.002	-0.004	0.000	-0.036*	0.013	0.011	0.016	0.139***	0.013	0.010	0.015	0.142***	0.010	0.008	0.012	0.135***	0.006	0.004	0.008	0.084***
Out-of-home (0 No)	-0.033	-0.068	0.001	-0.027	-0.016	-0.038	0.006	-0.021	-0.040	-0.076	-0.004	-0.031*	-0.008	-0.042	0.026	-0.007	-0.015	-0.043	0.013	-0.015	-0.043	-0.071	-0.015	-0.043**
Scholarship (0 Yes)	0.020	-0.016	0.056	0.016	-0.008	-0.030	0.015	-0.010	-0.010	-0.047	0.027	-0.008	0.003	-0.032	0.038	0.002	0.025	-0.004	0.055	0.025	-0.016	-0.045	0.014	-0.016
Phase (0 pre-COVID)	0.018	-0.021	0.056	0.013	0.025	0.000	0.049	0.029*	0.021	-0.019	0.061	0.014	-0.018	-0.056	0.020	-0.013	0.041	0.009	0.073	0.036*	0.018	-0.014	0.049	0.016

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$

Abbreviations: PMHQ-AT, Positive Mental Health Questionnaire-Autonomy; PMHQ-IP, Positive Mental Health Questionnaire-Interpersonal Skills; PMHQ-PA, Positive Mental Health Questionnaire-Pro-social Attitude; PMHQ-PP, Positive Mental Health Questionnaire-Problem Solving and Personal Fulfilment; PMHQ-PS, Positive Mental Health Questionnaire-Personal Satisfaction; PMHQ-SC, Positive Mental Health Questionnaire-self-control.

TABLE 5 Multiple Linear Regression of Mental Health Knowledge Questionnaire domains, Mental Health-promoting Knowledge and Psychological Vulnerability Scale

	MHKQ-KC			MHKQ-BE			MHKQ-AW			MHPK-10			PVS							
	95% CI B			95% CI B			95% CI B			95% CI B			95% CI B							
	B	LB	UB	Beta	B	LB	UB	Beta	B	LB	UB	Beta	B	LB	UB	Beta				
Gender (0 male)	4.685	3.704	5.665	0.139***	-6.840	-8.000	-5.680	-0.117***	9.740	7.520	11.980	0.128***	0.172	0.131	0.212	0.127***	0.238	0.177	0.298	0.109***
Age	0.013	-0.049	0.075	0.006	0.050	-0.030	0.120	0.019	0.390	0.250	0.530	0.083***	0.003	0.000	0.005	0.032*	-0.023	-0.026	-0.019	-0.169***
Out-of-home (0 No)	-1.217	-2.027	-0.407	-0.044**	3.740	2.780	4.690	0.113***	-2.250	-4.090	-0.410	-0.036*	-0.031	-0.064	0.003	-0.028	0.009	-0.041	0.059	0.005
Scholarship (0 Yes)	-0.056	-0.896	0.784	-0.002	0.540	-0.450	1.540	0.016	2.530	0.630	4.440	0.04**	0.017	-0.018	0.051	0.015	-0.062	-0.114	-0.001	-0.034*
Phase (0 pre-COVID)	0.428	-0.476	1.332	0.014	-1.510	-2.580	-0.440	-0.04**	0.370	-1.690	0.410	0.005	0.000	-0.037	0.037	0.000	-0.033	-0.089	0.023	-0.016

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

Abbreviations: MHKQ-AW, Mental Health Knowledge Questionnaire-Awareness of Mental Health Promotion Activities; MHKQ-BE, Mental Health Knowledge Questionnaire-Belief in the Epidemiology of Mental illnesses; MHKQ-KC, Mental Health Knowledge Questionnaire-Knowledge of the Characteristics of Mental Health and Mental illnesses; MHPK-10, Mental Health Knowledge Questionnaire-Total; MHPK-10, Mental Health-promoting Knowledge; PVS, Psychological Vulnerability Scale.

that aimed to identify the array of the psychological impact of COVID-19 on students from several universities in the United States, suggested that women are more likely to be strongly affected by the long-term psychological impact of the pandemic. One study concluded that some personal traits such as greater emotional expression, less tolerance for uncertainty, and less-effective coping strategies were more commonly observed in female students (Sundarasan *et al.* 2020).

Another study developed by Charles *et al.* (2021) about the increased mood disorder symptoms found that stress and alcohol use among college students during the COVID-19 pandemic were higher in women. This is especially of concern in young adult females adding to the high levels of anxiety and depression (Avery *et al.* 2020; Browning *et al.* 2021; Pollard *et al.* 2020). Some reasons can help explain young academic students' vulnerability, such as worries about their academic future and how they will provide for their education (Aristovnik *et al.* 2020). The active involvement of young academic students in personal and academic activities increases the likelihood of dissemination of COVID-19, which, in turn, can decrease their mental health and increase their anxiety (Browning *et al.* 2021; Huckins *et al.* 2020). Of the 11 variables tested in the regression model, the variable 'out of home' showed significant differences in five of these variables. Displaced students showed significantly lower positive mental health in specific domains: interpersonal skills ($\beta = -0.045$, $P < 0.01$) and self-control ($\beta = -0.031$, $P < 0.05$); and in two domains of mental health knowledge: knowledge of the characteristics of mental health and mental illnesses MHKQ-KC ($\beta = -0.044$, $P < 0.01$), and awareness of mental health promotion activities ($\beta = -0.036$, $P < 0.01$). Being out of home is a big concern for academic students. The novel virus has imposed rapid changes in all dimensions and uncertainty concerning university education promoted by b-learning teaching and technological needs. Many students experienced anxiety, and some suffered from depressive symptoms due to being away from home, socially isolated, and loss of family income. This was transversal evidence worldwide (Aristovnik *et al.* 2020; Browning *et al.*, 2020). Some factors that increased the risk of anxiety in students were not living with their parents and low family income (Aylie *et al.* 2020). Our study results revealed that students with a 'scholarship' were more psychologically vulnerable ($\beta = -0.034$, $P < 0.05$). However, they had more awareness of mental health promotion activities than students without this financial support ($\beta = 0.04$, $P < 0.01$). Lack of

support seemed to increase the negative impact on the students' economic, social, and health status. Also, students with poor social support had an almost three times higher risk of developing depression and stress than other students. Lack of social support may add pressure to economic, social, and health impacts. Furthermore, family financial support was a protective factor for college students who experienced anxiety during the COVID-19 outbreak (Cao *et al.* 2020).

The mental health of college students is often affected during pandemics or global emergencies requiring support and increased attention from other persons or organizations, including the community, families, and colleges. Professors and universities should consider strategies to maintain healthy mindsets and decrease stress in college students (Browning *et al.* 2021) and provide psychological counselling to help students perform better in their studies. The 'phase' triggers a change in students' beliefs in the epidemiology of mental illnesses ($\beta = -0.04$, $P < 0.01$), showing a decrease in the during-COVID phase. This can be explained by uncertain thoughts about their mental health vulnerability. In the during-COVID phase, students showed a higher pro-social attitude ($\beta = 0.029$, $P < 0.05$), possibly related to isolation during the lockdown and higher demands for problem-solving and personal fulfilment ($\beta = 0.036$, $P < 0.05$), caused by this novel event. The COVID-19 pandemic raised unprecedented concerns, isolation through social networks, lack of interaction and emotional support, and physical isolation associated with negative mental health trajectories (Elmer *et al.* 2020). In these situations, students are also at risk for serious health conditions and need particular attention.

Limitations and strengths

This study had some limitations. The primary concern was related to the different sampling before and after the first lockdown. It was not possible to study the same sample during the two moments because, at the beginning of the first phase of data collection, the COVID-19 pandemic was still unknown. Despite the identified limitations, these study results provide valuable evidence by recognizing the importance of mental health promotion. In recent studies concerning COVID-19, the focus was mainly on mental disease, particularly on academic studies rather than on variables that promote mental health, enabling the maximum delay of the onset of mental disease and the control over situations of mental disorder.

Another strength of this study relates to the number of Portuguese universities involved in this study. Students from twenty universities accepted to participate, providing the most extensive national sample involving the study of mental health of college students.

The psychometric properties of the measurement tool showed good results allowing its implementation in practice and confirming the robustness of data.

To the best of our knowledge, there are no current studies published on positive mental health, mental health knowledge, and psychological vulnerability in academic students. The number of variables involved in this study has provided additional evidence by allowing better results and comparison between both groups.

CONCLUSION

These cross-sectional studies showed that college students experience slight variation in mental health variables studied in the period before and during the COVID-19 pandemic. Being a woman, a young academic student, being away from home, and having a scholarship was likely related to increased susceptibility to mental health variation before and during the pandemic.

The COVID 'phase' was a predictor of lower students' beliefs in the epidemiology of mental illnesses and higher pro-social attitude, problem-solving, and personal fulfilment. Also, the student's psychological vulnerability was found to be strongly associated with worse positive mental health with a slight increase during COVID-19. The variables analysed in this study could help universities develop strategies that promote the mental health of higher education students. Future research should consider the development of longitudinal studies to confirm the present study results.

RELEVANCE FOR CLINICAL PRACTICE

The universities must include mental health policies in their strategic plans. Specific diagnostic and intervention programs should be defined, as well as programs, to promote the mental health of university students. These intervention programs should be transversal to all students, with particular attention, to the most psychologically vulnerable students, female, younger, out-of-home, and with scholarships (usually the most financially needy). The pandemic crisis only brought this reality to the fore, universities must provide their staff with mental health professionals specialized in this population.

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ETHICAL APPROVAL

Ethical approval was obtained from *Escola Superior de Enfermagem do Porto* (CE-ESEP – Fluxo 2019_1945).

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

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