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MESTRADO INTEGRADO EM MEDICINA

Sofia Isabel Tavares de Almeida

Psychological burden in

Portuguese university students

during COVID-19 pandemic

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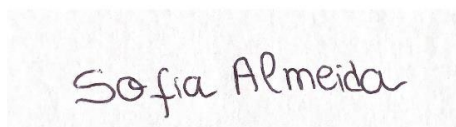Journal of Community Health

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Psychological burden in Portuguese university students during COVID-19 pandemic

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Dedicatória

À minha mãe, a melhor companheira de viagem que poderia ter. Um Obrigada nunca será suficiente.

Ao meu pai e Tio mané, pelo apoio e carinho incondicionais.

Às minhas amigas, pelo amor de sempre. Obrigada por terem dado um brilho especial a este percurso, bem como a tudo o resto na vida.

Psychological burden in Portuguese university students during COVID-19 pandemic

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ABSTRACT

This study aims to evaluate the psychological burden of the COVID-19 pandemic in the students of the University of Porto, the second largest Portuguese University, and to uncover factors associated with worse psychological indicators.

We used an online survey to perform a cross-sectional study that evaluated students' perceptions, lifestyle, and psychological well-being during the pandemic. Depression symptoms and risk were measured by the Patient Health Questionnaire-9 and resilience levels were quantified by the 9-item Resilience Evaluation Scale. Self-perceived levels of anxiety and current mental health status were evaluated.

Among 1751 responses obtained, 1447 were included. Most students were female (72.3%) and were taking a Master's degree (58.4%). The course with more responses was Engineering (25.5%), followed by Medicine (13.2%).

The prevalence rates for higher anxiety levels, depression risk and low resilience levels were 66.7%, 37.3% and 24.9%, respectively.

The factors associated with better psychological outcomes were being male, spending more time studying, having a job, performing extracurricular activities, physical exercise and relaxing activities.

In contrast, spending more time watching news, difficulty accessing online lectures and absence of contact with family or friends, were associated with worse psychological indicators.

Although all courses presented substantial levels of depressive symptoms, Architectures/Arts, Sciences and Humanities scored significantly more in the depression scale. Medicine students had significantly higher resilience levels compared to other courses.

Our findings identify factors associated with worse psychological outcomes and can be used to create protective measures for the mental health of university students during current and future pandemics.

Introduction

The coronavirus disease (COVID-19) is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) that emerged in China in late 2019. It has been declared a pandemic by the World Health Organization (WHO) and it is a public health emergency with severe impact on health, economy and human behaviour.

In Portugal, the first COVID-19 cases were confirmed on March 2nd, 2020, and the Portuguese government imposed the emergency state on March 19th. Since then, lockdown and self-isolation policies were implemented, and people have been hindered from their jobs, schools, common social interactions and outdoor activities. Despite the effectiveness of such policies in mitigating the spread of the virus, their damaging repercussions on mental health have been consistently reported [1].

Studies regarding previous infectious disease outbreaks requiring self-isolation measures have shown that individuals in quarantine presented higher levels of negative psychological outcomes, including depression, anxiety, insomnia and stress, compared with people who were not confined [2]. In addition, these effects could still be detected months or years after the isolation period.

The negative impact of the current pandemic on mental health status has also been reported among university students [3], who showed a higher psychological burden compared to the general population [4, 5].

Currently, the impact of COVID-19 pandemic in university students is a matter of concern worldwide. Closing universities implied dramatic changes in students' routines. Onsite classes were replaced by online sessions, leading to a reduction of social interaction among students, a factor known for increasing levels of stress, anxiety, and depressive thoughts in this population [6]. Furthermore, university students were faced with other potential stress factors such as major changes in education and evaluation methods, fear and worry about their own health and the health of their loved ones, and lifestyle readjustments imposed by lockdown.

We developed a study with the main objective of evaluating the pandemic's burden in university students' mental health, and to uncover factors associated with worse psychological indicators.

Furthermore, we evaluated, within the medical students' group, the impact of the pandemic in their perspectives towards medical practice and the choice of the medical specialty, as there are reports suggesting that they might feel less prepared for starting to work as medical doctors and they might change the specialty of interest [7, 8].

Methods

Participants and procedure

We conducted a cross-sectional study in one of the largest universities in Portugal, the University of Porto. More than 30.000 students from 14 different schools were invited to participate in an online survey. An electronic link, available between September and November 2020, was shared in several social media platforms, as well as through a dynamic email sent to

every student. Enrolment in the study was entirely voluntary and no effort was made to carry out purposive sampling. Participants had to complete and submit the survey to be included.

Ethical approval

Ethical approval was obtained from the Ethics Committee of Centro Hospitalar São João / Faculty of Medicine, University of Porto (reference 149/2020).

Students were informed about the study procedures and aims and notified that the participation was anonymous and voluntary. Confidentiality was ensured and exclusively the investigators had access to the data after anonymization.

Instruments

An original questionnaire was designed for the study intending to characterize sociodemographic factors, personal experience regarding SARS-CoV-2 infection, lifestyle changes, living conditions and students' perceptions about the pandemic's impact in their academic work. We also explored information sources and time spent in gathering information about the pandemic. Questions addressing the self-perceived mental health status and anxiety, and standardized measures of psychological wellbeing, depression and resilience were included in the survey.

The Portuguese version of the 9-item Patient Health Questionnaire (PHQ-9) was used to screen for symptoms of depression [9, 10]. The questionnaire is composed of 9 questions with a 4-point Likert scale ranging from 0 ("not at all") to 3 ("nearly every day"). The total score reaches a maximum of 27 and a cut-off of 10 was used to indicate the risk for depressive disorder [11].

The 9-item Resilience Evaluation Scale (RES) evaluates two underlying constructs of psychological resilience: self-confidence and self-efficacy. Each question is answered on a 5-point Likert scale ranging from "0 = totally disagree" to "4 = totally agree", with a total score

ranging from 0 to 36. The sample was divided into tertiles (e.g., 3 groups of equal size divided by the 33rd and 66th percentile) based on the total scores of the RES. The first tertile (scores ≤17) was assumed to represent low psychological resilience, the second (scores from 18 to 24) moderate psychological resilience, and the third (scores ≥25) high psychological resilience [12, 13].

Statistical analysis

Data analysis was conducted using IBM Statistics SPSS 26. An analysis using descriptive statistics was conducted to demonstrate the demographic and other selected characteristics of the respondents. As the data were not normally distributed, non-parametric tests were used to detect differences between groups and to perform a correlational analysis between variables. A *P* value < 0.05 was considered statistically significant.

Results

From the total of 1751 answers received, 304 were incomplete and 1447 were eligible for analysis.

The sociodemographic characteristics of the participants are shown in **Table 1**. Most students were female (72.3%) and were taking a Master's degree (58.4%).

The course with more responses was Engineering (25.5%), followed by Medicine (13.2%) (**Fig. S1**).

The most frequent daily activities reported by students were studying, activities that promote psychological well-being (e.g., conversations with friends, relaxing activities, listening to music) and activities that promote physical well-being (e.g., physical exercise) (**Fig. S2).**

Regarding academic activities, 1171 students (80.9%) attended online classes. Within this group, 18.2% had trouble accessing online lectures. Most students perceived this format as having a negative impact on teaching and learning (**Table S1**).

Psychological burden and mental health status

Results concerning self-perception of anxiety and mental health status, as well as depression and resilience scores, are shown in **Table 2.**

Most students (66.7%) reported higher levels of anxiety compared to the pre- pandemic period, and 14.6% considered their mental health status to be bad or very bad. Students scored, on average, 8.63 (SD= 6.19) in PHQ-9 depression scale. Overall, 37.3% of students incurred in high risk to develop a depressive disorder (PHQ-9> 10 points). Resilience evaluation showed a mean RES score of 21.78 (SD= 6.61), with most of the students reporting moderate to high resilience levels (40.4% and 34.6%, respectively).

Most students acknowledged positive aspects associated with the pandemic (**Fig. S3),** namely spending more time with family (41.2%), relaxing and resting (34.4%), dedicating more time to academic activities (32.3%) and to activities that promote psychological well-being (26.9%). The most frequently stressors or worry factors (**Fig. S4)** were family's health and well-being (90.7%), society's health and well-being (65.4%), self-health and well-being (64.3%), general economic situation (62.4%) and the impact of the pandemic in individual learning skills (58.5%). Regarding sadness or discouragement factors (**Fig. S5)**, the most selected ones included less physical contact with friends (82.2%), being hindered from doing desired outside activities (72.7%), and less physical contact with family (60.3%).

Medical students

Within the total sample, 183 participants were medical students. Most medical students agreed that their clinical skills (75.3%), and theoretical knowledge (50.8%) would be hindered. The

majority wished to be fighting against COVID-19 along with health professional workers (60.1%) and felt their skills could have had a better use during the pandemic (54.1%).

Students felt that the pandemic increased their desire to become medical doctors (59.6%), but most did not change the specialty they consider choosing in the future (59.5%)- **Table S2.**

Correlations between students' sociodemographic characteristics and psychological outcomes (Table S3)

No correlations were found between anxiety, depression, and resilience scores and age of the participants (p=0.355 for anxiety, Spearman's Correlation: r = -0.123, r = 0.120 for depression and resilience, respectively). Regarding gender, female students showed higher levels of anxiety (P<0.001), depression (P<0.001) and lower resilience (P=0.006) than male students. As the academic degree increases (Bachelor's→Master's→PhD) there were significant lower depressive symptoms (P<0.001) and higher resilience scores (P<0.001).

When the different courses were compared, there were significant differences regarding depressive symptomatology (P<0.001) and resilience scores (P<0.001). Medical students scored significantly more in the resilience scale, and Architectures/Arts, Sciences and Humanities exhibited higher risk for depression. There were no significant differences between the courses in what concerns increases in the perceived anxiety levels (P=0.196).

Correlations between students' activities, perceptions and experience during the pandemic and psychological state (Table 3-7)

Daily activities associated with lower anxiety and depressive symptoms, and higher resilience levels, were physical exercise and relaxing (both with P<0.001 in all mental health indicators). Having a job was correlated with lower depression scores (P<0.001), whereas taking care of someone sick had the opposite effect (P<0.001). Participating in extracurricular activities was associated with higher resilience scores (P=0.016).

Students maintaining contact with family were more likely to be resilient (P=0.021), less anxious (P=0.038) and reported fewer depressive symptoms (P<0.001). Contact with friends was significantly associated with lower depression symptomatology (P=0.008) and more resilience (P=0.018), but the association with anxiety was not statistically significant (P=0.656).

There was an association with better mental health indicators if the students felt satisfaction with the public health measures adopted by the school (P=0.004 for anxiety, P<0.001 for depression, P=0.003 for resilience), by the university (P=0.001 for anxiety, P<0.001 for depression, P=0.002 for resilience), and by the government and official health entities (P=0.007 for anxiety, depression P=0.050, and resilience P=0.090).

Students who had trouble accessing online classes were more likely to have increased anxiety levels (P<0.001) and depressive symptoms (P<0.001). The perception that the pandemic would hinder learning was significantly associated with a worse psychological state (P<0.001 for all psychological outcomes). Dedicating more time to study than before the pandemic was correlated with lower anxiety and depression scores (P<0.001).

Spending more time watching news was associated with feeling more anxious (P=0.004). Obtaining information from World Health Organization (WHO) or national Directorate-General of Health (NDGH) or was also associated with higher levels of anxiety (P=0.010), whereas information through social networks was associated with more depressive symptoms (P=0.007). Students who felt properly informed about the pandemic scored significantly less in the depression scale (P=0.003).

Students exposed to COVID-19 or with a relative/friend dying from COVID-19, were more likely to experience anxiety (P=0.029 and P=0.033, respectively), but there was no association with depressive symptoms (P=0.178 and P=0.613, respectively). Students who had a

relative/friend infected were more likely to be more anxious (P=0.001) and to report depressive symptoms (P=0.003).

Discussion

Our study suggests that the COVID-19 pandemic had a significant impact in the psychological well-being of University of Porto's students. This corroborates previous studies developed during the outbreak of the virus regarding students [3, 14, 15] and general population [16, 17].

In our sample, being a female was associated with higher levels of anxiety and depression symptoms and with lower resilience. This agrees with several previous studies among the general population [17, 18], and among university students [19]. Concerning the academic degree, our results showed that higher academic degrees are associated with lower depression and higher resilience scores. This was not due to higher ages, since we did not find differences in mental health indicators when it comes to age, in agreement with previous findings [4]. We can speculate that higher educational achievement, more than age, protects students from pandemic emotional challenges.

Being diagnosed with COVID-19 or having contact with someone infected was associated with higher anxiety, which is in line with several previous reports [2, 4]. Having a family member or friend diagnosed or deceased by COVID-19 or taking care of someone sick was related to poorer mental health outcomes [15, 20], which is understandable, due to the heavy emotional cost associated.

The activities linked to a better outcome in all three mental health indicators were physical exercise (and other promoting physical well-being activities) and relaxing (among other promoting psychological well-being activities). Students who had a job were more likely to be resilient and have fewer depressive symptoms. Having a job was also found to be associated

with better psychological outcomes in the general population. Additionally, participating in extracurricular activities was correlated with higher resilience scores. These results obtained in this university population agree with results obtained in larger populations [18, 21, 22].

When asked about positive aspects of the pandemic, students who felt they were "able to try a new activity", had "more time spent with family", had "more time talking with friends online" or "less things to do or more time to do them" showed significant better psychological outcome. Interestingly, students who selected "none of the previous" had a worse outcome in all mental health indicators. Whereas recognizing positive aspects in the pandemic period may hint for a protective effect for psychological well-being, these results can also mean that being in a worst psychological condition may compromise the ability to perceive such aspects.

Our findings also suggest that having regular contact with family or friends is associated with better psychological outcomes. These results show the importance of preserving social interaction during the pandemic period. Having this in mind, universities could foster interaction between the students during pandemics, namely through virtual platforms.

We studied if students' perceptions regarding academic activities were related with their psychological well-being. In fact, difficulty accessing online lectures seemed to be a predisposing factor for anxiety and depression symptoms. Furthermore, students who felt the pandemic would have a negative impact in their learning and evaluation reported worst psychological condition in the evaluated parameters. Interestingly, dedicating more time to study was associated with better mental health indicators. Previous studies reported similar findings in what concerns work in non-academic contexts [18, 21] but, to the best of our knowledge, no reports specifically addressed the role of engagement in study activities at the university. These results suggest that having objectives and activities to do can be a protective factor for mental health.

We found that spending more time watching news is significantly correlated with higher levels of anxiety, in agreement with previous reports [5, 18, 23]. Watching news can be a predisposing factor for anxiety and/or students who feel more anxious may have the urge to feel better informed. However, time spent watching news had no significant impact in depression scores and resilience levels. Despite this lack of association, previous studies show that students who feel more informed about the pandemic are less likely to be depressed [24]. This might be explained by the fact that perceived information is not proportionally directed to time spent watching news, which led us to believe that promoting information about the pandemics in a clear, concise and effective manner should be a priority during a pandemic. Curiously, students who reported obtaining information in WHO or NDGH felt higher levels of anxiety, compared to media and social networks. An explanation for these findings is that feeling worried about the pandemic can motivate searching for information in more reliable sources of information. On the other hand, students who got the information in social networks scored significantly more in the depression scale. Students should be aware of the impact of the information sources as they may provide data in different manners. In fact, messages from media and social networks may have an affective value that can impact mental health conditions [25, 26].

Interestingly, when the different courses were compared, medical students showed significantly higher scores of resilience. Architectures/Arts, Sciences and Humanities presented higher depressive symptoms. Concerning anxiety levels, there were no significant differences between all courses. Some studies have suggested that medical students display higher levels of anxiety and depression, compared with non-medical students [14, 27]. Although our data seem to confirm high anxiety and depression scores in medical students, this also happens in students from other courses [28].

Our results show that being satisfied with the attitudes taken by the school, university and government and health agencies is associated to better psychological outcomes, which enlarges

the impact of a previous study directed to the perceptions of the general population towards governmental measures [17].

Conclusion

To the best of our knowledge, this is the only study regarding the psychological impact of COVID-19 pandemic in University of Porto's students. Although these results were taken from a particular university, they may provide similar insights for other higher education students. The similarities between some of the results and other studies directed to the general population support the validity of the analysis.

Additionally, the study demonstrates which groups might be more affected by the pandemic and which factors might be associated with worse psychological outcomes. This can be important for creating protective measures for university students, especially those in the more vulnerable groups.

Although confinement procedures are effective in controlling the spread of the virus, they have a significant effect in the psychological well-being of university students. There should be a collaboration between universities, government and health entities to provide greater care to students and mitigate the impact of the current and future public health emergencies. These interventions should be maintained after the end of the confinement measures, as these may cause long-term effects.

Limitations of this study

Due to the sampling method, we could not ensure data's normal distribution. Therefore, we had to use non-parametric tests, which are usually less powerful than corresponding parametric tests when the normality assumption holds.

Furthermore, as we conducted a cross-sectional study, the causality is not clarified. It would be ideal to conduct a prospective study on the same group of participants.

As we conducted a self-administered online survey, we are vulnerable to have response bias.

Another limitation concerns the fact that self-reported levels of anxiety and self-perceived mental health status might not be aligned with the objective evaluation made by mental health professionals. Besides, for higher validation, we could have used standardized scales to quantify these two indicators.

Compliance with Ethical Standards

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Table 1 | Sociodemographic characteristics and personal experience with COVID-19 (n=1447)

Variable	Mean	SD
Age (in years)	21.92	6.067
	n	**Percentage**
Gender		
Female	1046	72.3%
Male	396	27.4%
Other	5	0.3%
Graduate degree		
Bachelor's degree	529	36.6%
Master's degree	844	58.4%
PhD	74	5.1%
Exposure to COVID-19		
Mandatory quarantine for diagnosis	38	2.6%
Prophylactic isolation for contact with someaone diagnosed	167	11.5%
None of the previous	1242	85.8%
Relatives/ friends infected		
Yes	508	35.1%
No	939	64.9%
Relatives/ friends died from infection		
Yes	55	3.8%
No	1392	96.2%

Table 2| Pandemic's burden in mental health status (n=1447)

Variable	n	%
Feel more anxious than before the pandemic		
No	482	33.3%
Yes	965	66.7%
Mental health status self-perception		
Very good	162	11.2%
Good	541	37.4%
Satisfactory	534	36.9%
Bad	186	12.9%
Very bad	24	1.7%
PHQ-9 total score [a]		
Risk of depressive disorder	540	37.3%
RES total score [b]		

Low psychological resilience		361	24.9%						
Moderate psychological resilience		585	40.4%						
High psychological resilience		501	34.6%						

[a] Mean 8.63; SD 6.19.
[b] Mean 21.78; SD 6.61.

Table 3 | Correlation between personal experience with COVID-19 and mental health indicators

Variable	Anxiety			PHQ-9			RES 9-item		
	Yes (n)	No (n)	P value	Mean	SD	P value	Mean	SD	P value
Exposure to COVID-19			P=0.029 [a]			P=0.178[c]			P=0.153 [c]
Mandatory quarantine for diagnosis	27	11		9.13	6.35		23.05	6.14	
Prophylactic isolation for contact with someone diagnosed	126	41		9.58	6.75		22.44	7.19	
None of the previous	812	430		8.49	6.09		21.65	6.53	
Relatives/ friends infected			P=0.001 [a]			P=0.003 [b]			P=0.690 [b]
Yes	366	142		9.25	6.25		22.22	6.38	
No	599	340		8.30	6.12		21.54	6.71	
Relatives/ friends died from infection			P=0.033 [a]			P=0.613 [b]			P=0.611 [b]
Yes	44	11		8.98	6.16		22.16	7.13	
No	921	471		8.62	6.19		21.76	6.58	

[a] P value: Chi-square test.
[b] P value: Mann-Whitney U test.
[c] P value: Kruskal-Wallis test.

Table 4 | Correlation between daily activities and contact with family/friends during the pandemic and mental health indicators

Variable	Anxiety			PHQ-9			RES 9-item		
	Yes (n)	No (n)	P value [a]	Mean	SD	P value [b]	Mean	SD	P value [b]
Daily activities									
Study			P=0.305			P=0.486			P=0.097
Yes	935	462		8.60	6.15		21.85	6.57	
No	30	20		9.58	7.27		19.76	7.40	
Work			P=0.207			P=0.001			P<0.001
Yes	211	119		7.67	5.91		23.55	6.33	
No	754	363		8.92	6.24		21.26	6.60	
Volunteer			P=0.934			P=0.458			P=0.144
Yes	71	35		8.87	6.75		22.42	6.42	
No	894	447		8.62	6.14		21.73	6.62	
Extracurricular activities			P=0.426			P=0.603			P=0.016
Yes	278	148		8.81	6.30		22.42	6.33	
No	687	334		8.56	6.14		21.51	6.70	
Physical exercise (and other promoting physical well-being activities)			P<0.001			P<0.001			P<0.001
Yes	477	299		7.38	5.42		23.20	6.04	
No	488	183		10.09	6.69		20.13	6.85	
Relaxing (and other promoting			P<0.001			P<0.001			P<0.001

Variable	Anxiety Yes (n)	No (n)	P value	PHQ-9 Mean	SD	P value	RES 9-item Mean	SD	P value
psychological well-being activities)									
No	687	384		8.16	5.91		22.27	6.35	
Yes	287	98		9.94	6.73		20.42	7.10	
Take care of someone sick			P=0.209			P<0.001			P=0.141
Yes	28	8		11.97	5.59		20.14	5.72	
No	937	474		8.55	6.18		21.82	6.62	
House tasks			P=0.696			P=0.519			P=0.178
Yes	488	238		8.52	6.07		22.05	6.45	
No	477	244		8.75	6.30		21.50	6.75	
Contact with family			P=0.038			P<0.001			P=0.021
Yes (at least some)	754	399		8.21	6.05		21.97	6.60	
None	211	83		10.30	6.46		21.01	6.60	
Contact with friends			P=0.656			P=0.008			P=0.018
Yes (at least some)	757	383		8.36	5.98		21.99	6.51	
None	208	99		9.64	6.82		20.99	6.90	

[a] P value: Chi-square test.
[b] P value: Mann-Whitney U test.

Table 5| Correlation between academic activities and perceptions during the pandemic and mental health indicators

Variable	Anxiety			PHQ-9			RES 9-item		
	Yes (n)	No (n)	P value [a]	Mean	SD	P value	Mean	SD	P value
Participating in online academic activities			P=0.089			P=0.222 [b]			P=0.941 [b]
Yes	793	378		8.73	6.20		21.80	6.65	
No	172	104		8.22	6.12		21.70	6.41	
Trouble accessing online classes			P<0.001			P<0.001 [b]			P<0.001 [b]
Yes	170	43		12.15	6.30		19.91	6.76	
No	623	335		7.97	5.92		22.22	6.56	
Feeling that the pandemic will hinder learning			P<0.001			P<0.001 [b]			P<0.001 [b]
Yes	726	254		9.85	6.28		20.96	6.58	
No	239	228		6.30	5.28		23.60	6.45	
Time dedicated to academic work compared to before the pandemic			P<0.001			P<0.001 [b]			P<0.001 [b]
More time	582	275		8.46	6.03		22.28	6.50	
Less/the same time	383	207		9.14	6.44		21.06	6.82	

[a] P value: Chi-square test.
[b] P value: Mann-Whitney U test.

Table 6| Correlation between time spent watching news and satisfaction with measures adopted during the pandemic and mental health indicators

Variable	Anxiety	PHQ-9	RES 9-item

	Yes (n)	No (n)	P value [a]	Mean	SD	P value	Mean	SD	P value
Time spent watching news per day			P=0.004			P=0.693 [c]			P=0.761 [c]
None	64	44		9.19	6.80		21.77	6.66	
Less than 30 minutes	558	314		8.48	6.16		21.60	6.60	
30-60 minutes	220	83		8.58	6.07		22.13	6.66	
1 hour	83	32		9.08	6.24		21.83	6.61	
2-3 hours	32	8		9.57	6.15		22.20	6.39	
More than 3 hours	8	1		9.00	5.59		24.67	6.36	
Feeling properly informed			P=0.941			P=0.003 [b]			P=0.040 [b]
Yes	804	401		8.43	6.13		21.96	6.55	
No	161	81		9.65	6.37		20.88	6.80	
Satisfaction about the measures adopted									
By school			P=0.004			P<0.001 [b]			P=0.003 [b]
Yes	577	312		7.96	5.95		22.52	6.20	
No	251	91		10.15	6.85		20.98	7.62	
By university			P=0.001			P<0.001 [b]			P=0.002 [b]
Yes	539	309		7.98	5.97		22.60	6.32	
No	212	72		10.20	6.84		20.63	7.30	
By government and health entities			P=0.007			P=0.050 [b]			P=0.090 [b]
Yes	389	224		8.12	5.99		22.42	6.46	
No	323	130		9.08	6.60		21.70	6.82	

[a] P value: Chi-square test.
[b] P value: Mann-Whitney U test.
[c] P value: Kruskal-Wallis test.

Table 7 | Positive aspects of pandemic

Variable	Anxiety			PHQ-9			RES 9-item		
	Yes (n)	No (n)	P value [a]	Mean	SD	P value [b]	Mean	SD	P value [b]
Dedicate more time to activities that promote psychological well-being			P<0.001			P<0.001			P=0.015
Yes	215	174		7.26	5.49		22.45	6.41	
No	750	308		9.14	6.35		21.53	6.66	
Able to try a new activity			P=0.008			P=0.021			P=0.448
Yes	138	97		7.70	5.68		22.16	6.39	
No	827	385		8.82	6.27		21.70	6.65	
More time relaxing and resting			P<0.001			P<0.001			P=0.002
Yes	263	235		7.26	5.46		22.48	6.28	
No	702	247		9.35	6.42		21.41	6.74	

Have less things to do or more time to do them			P<0.001			P<0.001		P<0.001
Yes	92	122		6.45	5.47		22.92	6.55
No	873	360		9.01	6.23		21.58	6.60
More time dedicated to academic activities			P<0.001			P<0.001		P<0.001
Yes	275	193		7.13	5.46		23.12	6.08
No	690	289		9.35	6.38		21.13	6.75
More time dedicated to physical exercise			P<0.001			P<0.001		P<0.001
Yes	223	153		6.84	5.16		23.28	5.88
No	742	329		9.26	5.16		21.25	6.77
More time spent with family			P=0.061			P<0.001		P<0.001
Yes	381	215		7.47	5.59		22.71	6.34
No	584	267		9.45	6.45		21.13	6.72
More time talking to friends online			P=0.281			P=0.008		P=0.094
Yes	204	115		7.83	5.90		22.31	6.22
No	761	367		8.86	6.25		21.63	6.71
None of the previous			P<0.001			P<0.001		P<0.001
Yes	250	46		12.18	6.78		19.72	7.22
No	715	436		7.72	5.68		22.31	6.33

[a] P value: Chi-square test.
[b] P value: Mann-Whitney U test.

Supplementary Material
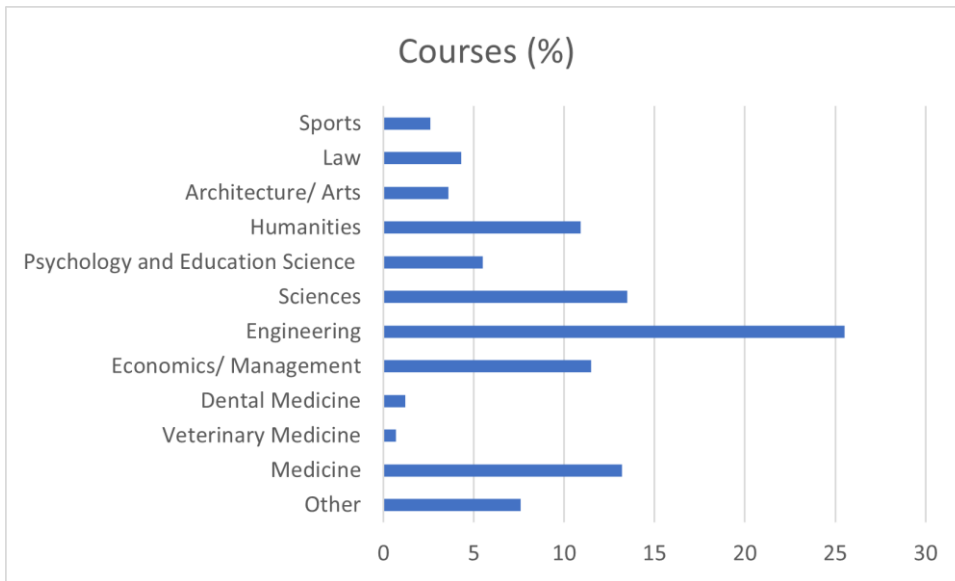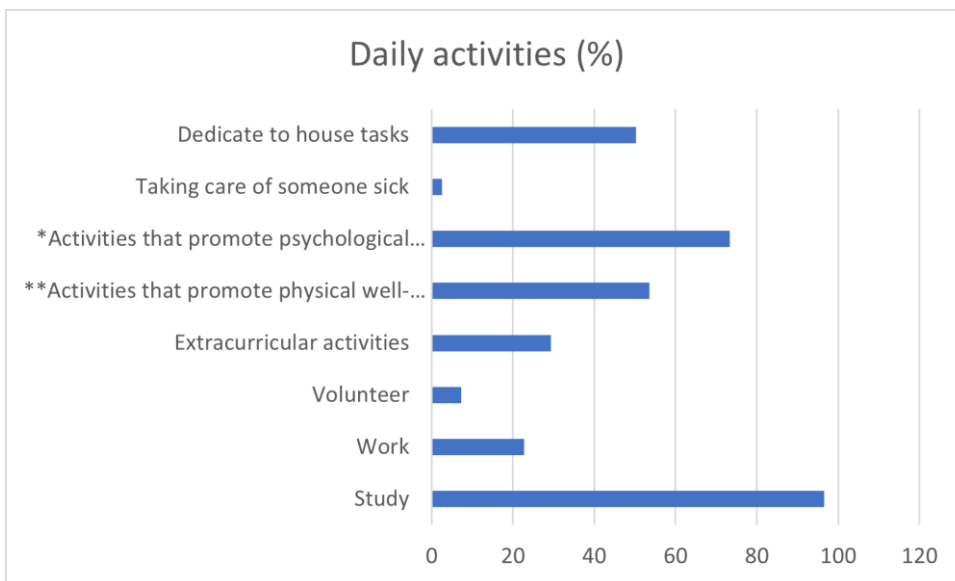
Courses (%)

Course	Percentage
Sports	~3
Law	~4
Architecture/ Arts	~3
Humanities	~11
Psychology and Education Science	~6
Sciences	~13
Engineering	~26
Economics/ Management	~11
Dental Medicine	~1
Veterinary Medicine	~1
Medicine	~13
Other	~7

Fig.S1

Daily activities (%)

Activity	Percentage
Dedicate to house tasks	~52
Taking care of someone sick	~3
*Activities that promote psychological...	~74
**Activities that promote physical well-...	~55
Extracurricular activities	~30
Volunteer	~8
Work	~23
Study	~96

*Activities that promote psychological well-being (e.g., conversations with friends, relaxing activities, listening to music)
**Activities that promote physical well-being being (e.g., physical exercise)
Fig.S2

Table S1| Academic activities and perceptions (n=1447)

Variable	n	Percentage
Perceived impact of on-line teaching in learning		

Very negative	172	11.9%
Slightly negative	744	51.4%
No impact	163	11.3%
Slightly positive	264	18.2%
Very positive	104	7.2%
Perceived impact of on-line teaching in evaluation		
Very negative	166	11.5%
Slightly negative	583	40.3%
No impact	311	21.5%
Slightly positive	306	21.1%
Very positive	81	5.6%
Feeling that the pandemic will hinder learning		
Yes	980	67.7%
No	467	32.3%
Time dedicated to academic work compared to before the pandemic		
Much less	45	3.1%
Less	203	14.0%
Equal	342	23.6%
More	619	42.8%
Much more	238	16.4%
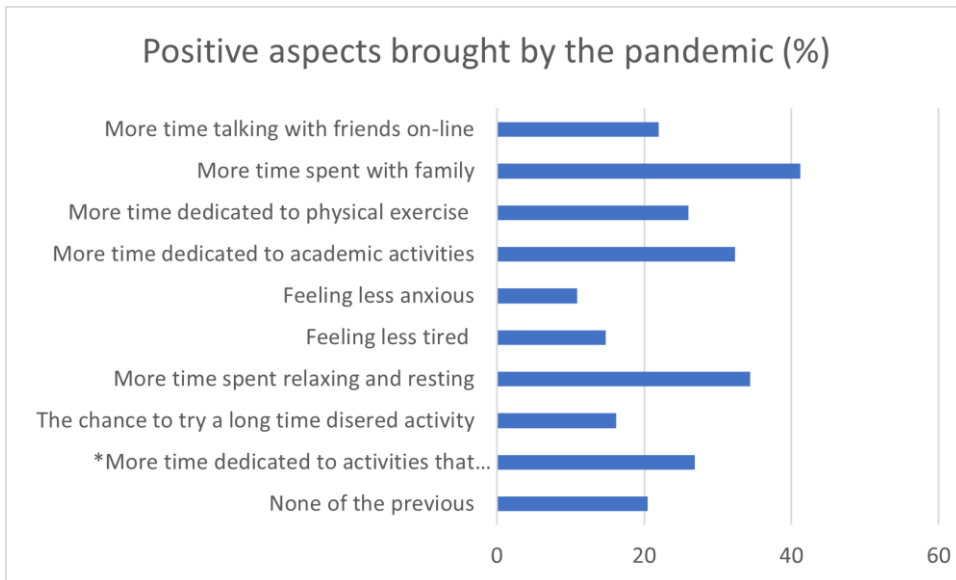
Fig.S3.

*More time dedicated to activities that promote my psychological well-being
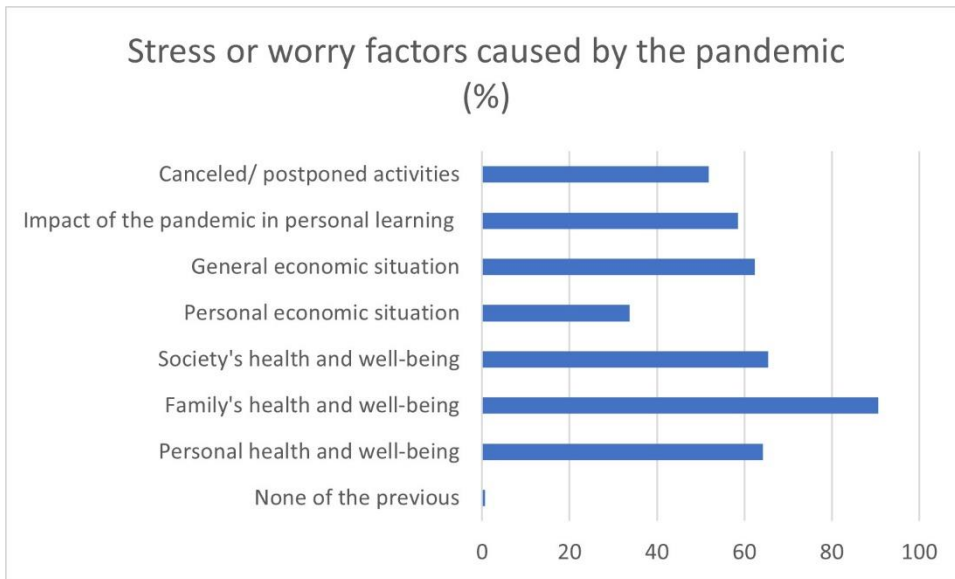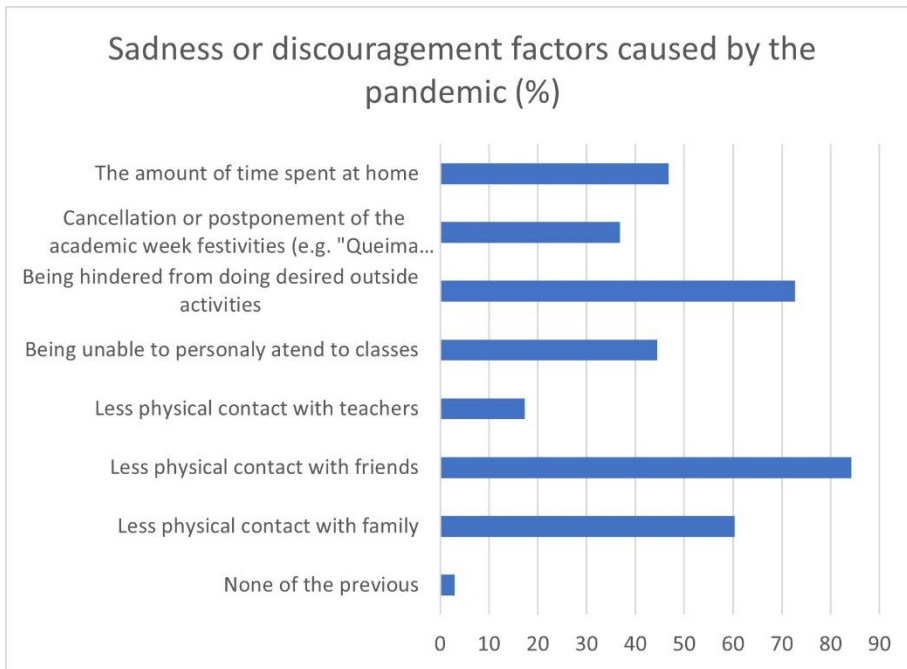
Fig.S4

Fig.S5

Table S2| Medical students (n=183)

Variable	n	%
Academic year		
1st	53	29.0%
2nd	32	17.5%
3rd	22	12.0%
4th	22	12.0%
5th	22	12.0%
6th	32	17.5%
Medical students' perceptions towards the pandemic:		
• **Theorical skills will be hindered**		

Strongly disagree	20	10.9%
Disagree	73	39.9%
Neutral	27	14.6%
Agree	48	26.2%
Strongly agree	15	8.2%

- **Clinical skills will be hindered**

Strongly disagree	1	.55%
Disagree	11	6.0%
Neutral	33	18.0%
Agree	61	33.3%
Strongly agree	77	42.0%

- **Wish to be in front line along with health professional workers**

Strongly disagree	2	1.1%
Disagree	15	8.2%
Neutral	56	30.6%
Agree	76	41.5%
Strongly agree	34	18.6%

- **Felt their skills could have had a better use during the pandemic**

Strongly disagree	3	1.6%
Disagree	30	16.4%
Neutral	51	27.9%
Agree	80	43.7%
Strongly agree	19	10.4%

- **Felt increased desire to become doctors**

Strongly disagree	1	.55%
Disagree	11	6.0%
Neutral	37	20.2%
Agree	76	41.5%
Strongly agree	58	18.6%

- **The pandemic didn't change the specialty they consider choosing**

Strongly disagree	6	3.3%
Disagree	27	14.8%
Neutral	41	22.4%
Agree	63	34.4%
Strongly agree	46	25.1%

Table S3 | Correlation between sociodemographic characteristics and mental health indicators

Variable	Anxiety			PHQ-9			RES 9-item		
	Yes (n)	No (n)	P value	Mean	SD	P value	Mean	SD	P value
Gender			P<0.001[a]			P<0.001			P=0.006 [b]
Female	735	311		9.04	6.22	[b]	21.54	6.54	
Male	227	169		7.50	5.87		22.49	6.66	
Graduate degree			P=0.790 [a]			P<0.001 [c]			P<0.001 [c]
Bachelors degree	358	169		9.49	6.49	*	20.99	6.75	*
Masters degree	148	82		8.33	6.00		22.03	6.54	
PhD	48	26		6.00	4.87		24.51	5.24	
Courses			P=0.196 [a]			P<0.001 [c]			P<0.001 [c]
						* **			* ***

[a] P value: Chi-square test.
[b] P value: Mann-Whitney U test.
[c] P value: Kruskal-Wallis test.
*Significance values have been adjusted by the Bonferroni correction for multiple tests.

Age had no correlation with anxiety (P=0.355 with Mann-Whitney U test), depression (Spearman's Correlation: r=-0.123) or resilience (Spearman's Correlation: r=0.120).
** Architectures/Arts, Sciences and Humanities students scored significantly more in the depression scale.
*** Medicine students scored significantly more in the depression scale.

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	7
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	7
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	8;9
Objectives	3	State specific objectives, including any prespecified hypotheses	9
Methods			
Study design	4	Present key elements of study design early in the paper	9
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	9;10
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	9;10
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	10;11
Bias	9	Describe any efforts to address potential sources of bias	10;11
Study size	10	Explain how the study size was arrived at	9;10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	11
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	11
		(*b*) Describe any methods used to examine subgroups and interactions	11
		(*c*) Explain how missing data were addressed	10
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	11
		(*e*) Describe any sensitivity analyses	N.A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	11
		(b) Give reasons for non-participation at each stage	N.A
		(c) Consider use of a flow diagram	N.A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11
		(b) Indicate number of participants with missing data for each variable of interest	11
Outcome data	15*	Report numbers of outcome events or summary measures	11;12

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13;14;15
		(*b*) Report category boundaries when continuous variables were categorized	10;11
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N.A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	12;13
Discussion			
Key results	18	Summarise key results with reference to study objectives	15;16;17;18
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15;16;17
Generalisability	21	Discuss the generalisability (external validity) of the study results	18
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	19

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.~

Translation:

Title and abstract (1)

(a) "We used an online survey to perform a cross-sectional study that evaluated students' perceptions, lifestyle, and psychological well-being during the pandemic."

(b) "This study aims to evaluate the psychological burden of the COVID-19 pandemic in the students of the University of Porto, the second largest Portuguese University, and to uncover factors associated with worse psychological indicators.

We used an online survey to perform a cross-sectional study that evaluated students' perceptions, lifestyle, and psychological well-being during the pandemic. Depression symptoms and risk were measured by the

Patient Health Questionnaire-9 and resilience levels were quantified by the 9-item Resilience Evaluation Scale. Self-perceived levels of anxiety and current mental health status were evaluated.

Among 1751 responses obtained, 1447 were included. Most students were female (72.3%) and were taking a Master's degree (58.4%). The course with more responses was Engineering (25.5%), followed by Medicine (13.2%).

The prevalence rates for higher anxiety levels, depression risk and low resilience levels were 66.7%, 37.3% and 24.9%, respectively.

The factors associated with better psychological outcomes were being male, spending more time studying, having a job, performing extracurricular activities, physical exercise and relaxing activities.

In contrast, spending more time watching news, difficulty accessing online lectures and absence of contact with family or friends, were associated with worse psychological indicators.

Although all areas of formation presented substantial levels of depressive symptoms, Architectures/Arts, Sciences and Humanities scored significantly more in the depression scale. Medicine students had significantly higher resilience levels compared to other areas of formation."

Introduction

2) "The coronavirus disease (COVID-19) is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) that emerged in China in late 2019. It has been declared a pandemic by the World Health Organization (WHO) and it is a public health emergency with severe impact on health, economy and human behaviour.

In Portugal, the first COVID-19 cases were confirmed on March 2nd, 2020, and the Portuguese government imposed the emergency state on March 19th. Since then, lockdown and self-isolation policies were implemented, and people have been hindered from their jobs, schools, common social interactions and outdoor activities. Despite the effectiveness of such policies in mitigating the spread of the virus, their damaging repercussions on mental health have been consistently reported [1].

Studies regarding previous infectious disease outbreaks requiring self-isolation measures have shown that individuals in quarantine presented higher levels of negative psychological outcomes, including depression, anxiety, insomnia and stress, compared with people who were not confined [2]. In addition, these effects could still be detected months or years after the isolation period.

The negative impact of the current pandemic on mental health status has also been reported among university students [3], who showed a higher psychological burden compared to the general population [4, 5].

Currently, the impact of COVID-19 pandemic in university students is a matter of concern worldwide. Closing universities implied dramatic changes in students' routines. Onsite classes were replaced by online sessions, leading to a reduction of social interaction among students, a factor known for increasing levels of stress, anxiety, and depressive thoughts in this population [6]. Furthermore, university students were faced with other potential stress factors such as major changes in education and evaluation methods, fear and worry about their own health and the health of their loved ones, and lifestyle readjustments imposed by lockdown."

3) "We developed a study with the main objective of evaluating the pandemic's burden in university students' mental health, and to uncover factors associated with worse psychological indicators.

Furthermore, we evaluated, within the medical students' group, the impact of the pandemic in their perspectives towards medical practice and the choice of the medical specialty, as there are reports suggesting that they might feel less prepared for starting to work as medical doctors and they might change the specialty of interest [7, 8]."

Methods

4) "We conducted a cross-sectional study in one of the largest universities in Portugal, the

University of Porto. More than 30.000 students from 14 different schools were invited to participate

in an online survey."

5) "An electronic link, available between September and November 2020, was shared in several

social media platforms, as well as through a dynamic email sent to every student."

6) "More than 30.000 students from 14 different schools were invited to participate in an online survey."; "Enrolment in the study was entirely voluntary and no effort was made to carry out purposive sampling. Participants had to complete and submit the survey to be included."

7) "An original questionnaire was designed for the study intending to characterize sociodemographic factors, personal experience regarding SARS-CoV-2 infection, lifestyle changes, living conditions and students' perceptions about the pandemic's impact in their academic work. We also explored information sources and time spent in gathering information about the pandemic. Questions addressing the self-perceived mental health status and anxiety, and standardized measures of psychological wellbeing, depression and resilience were included in the survey."

8) "The Portuguese version of the 9-item Patient Health Questionnaire (PHQ-9) was used to screen for symptoms of depression [9, 10]. The questionnaire is composed of 9 questions with a 4-point Likert scale ranging from 0 ("not at all") to 3 ("nearly every day"). The total score reaches a maximum of 27 and a cut-off of 10 was used to indicate the risk for depressive disorder [11].

The 9-item Resilience Evaluation Scale (RES) evaluates two underlying constructs of psychological resilience: self-confidence and self-efficacy. Each question is answered on a 5-point Likert scale ranging from "0 = totally disagree" to "4 = totally agree", with a total score ranging from 0 to 36. The sample was divided into tertiles (e.g., 3 groups of equal size divided by the 33rd and 66th percentile) based on the total scores of the RES. The first tertile (scores ≤17) was assumed to represent low psychological resilience, the second (scores from 18 to 24) moderate psychological resilience, and the third (scores ≥25) high psychological resilience [12, 13]."

9) "Enrolment in the study was entirely voluntary and no effort was made to carry out purposive sampling."; "Confidentiality was ensured and exclusively the investigators had access to the data after anonymization."; "As the data were not normally distributed, non-parametric tests were used to detect differences between groups and to perform a correlational analysis between variables."

10) "We conducted a cross-sectional study in one of the largest universities in Portugal, the

University of Porto. More than 30.000 students from 14 different schools were invited to participate

in an online survey. An electronic link, available between September and November 2020, was shared in several social media platforms, as well as through a dynamic email sent to every student."

11) "An analysis using descriptive statistics was conducted to demonstrate the demographic and other selected characteristics of the respondents."

12)

    (a) "Data analysis was conducted using IBM Statistics SPSS 26. An analysis using descriptive statistics was conducted to demonstrate the demographic and other selected characteristics of the respondents. As the data were not normally distributed, non-parametric tests were used to detect differences between groups and to perform a correlational analysis between variables. A P value < 0.05 was considered statistically significant."

    (b) "As the data were not normally distributed, non-parametric tests were used to detect differences between groups and to perform a correlational analysis between variables. A P value < 0.05 was considered statistically significant."

    (c) "Participants had to complete and submit the survey to be included."

    (d) "An analysis using descriptive statistics was conducted to demonstrate the demographic and other selected characteristics of the respondents. As the data were not normally distributed, non-parametric tests were used to detect differences between groups and to perform a correlational analysis between variables. A P value < 0.05 was considered statistically significant."

    (e) Not applicable, as we did not perform a sensitivity analysis.

Results

13)

    (a) "From the total of 1751 answers received, 304 were incomplete and 1447 were eligible for analysis."

    (b) Not applicable, as we did not inquire the reasons for non-participation.

(c) Not applicable, as we did not use a flow diagram.

14)

(a) "The sociodemographic characteristics of the participants are shown in **Table 1**. Most students were female (72.3%) and were taking a Master's degree (58.4%).

The course with more responses was Engineering (25.5%), followed by Medicine (13.2%) (**Fig. S1**)."

(b) "From the total of 1751 answers received, 304 were incomplete".

15) "The most frequent daily activities reported by students were studying, activities that promote psychological well-being (e.g., conversations with friends, relaxing activities, listening to music) and activities that promote physical well-being (e.g., physical exercise) **(Fig. S2)"; "**Regarding academic activities, 1171 students (80.9%) attended online classes. Within this group, 18.2% had trouble accessing online lectures. Most students perceived this format as having a negative impact on teaching and learning (**Table S1**)."; "Results concerning self-perception of anxiety and mental health status, as well as depression and resilience scores, are shown in **Table 2.** Most students (66.7%) reported higher levels of anxiety compared to the pre- pandemic period, and 14.6% considered their mental health status to be bad or very bad. Students scored, on average, 8.63 (SD= 6.19) in PHQ-9 depression scale. Overall, 37.3% of students incurred in high risk to develop a depressive disorder (PHQ-9 > 10 points). Resilience evaluation showed a mean RES score of 21.78 (SD= 6.61), with most of the students reporting moderate to high resilience levels (40.4% and 34.6%, respectively).

Most students acknowledged positive aspects associated with the pandemic (**Fig. S3**), namely spending more time with family (41.2%), relaxing and resting (34.4%), dedicating more time to academic activities (32.3%) and to activities that promote psychological well-being (26.9%). The most frequently stressors or worry factors (**Fig. S4**) were family's health and well-being (90.7%), society's health and well-being (65.4%), self-health and well-being (64.3%), general economic situation (62.4%) and the impact of the pandemic in

individual learning skills (58.5%). Regarding sadness or discouragement factors (**Fig. S5**), the most selected ones included less physical contact with friends (82.2%), being hindered from doing desired outside activities (72.7%), and less physical contact with family (60.3%).".

16)

(a) "No correlations were found between anxiety, depression, and resilience scores and age of the participants (p=0.355 for anxiety, Spearman's Correlation: $r = -0.123$, $r = 0.120$ for depression and resilience, respectively). Regarding gender, female students showed higher levels of anxiety (P<0.001), depression (P<0.001) and lower resilience (P=0.006) than male students. As the academic degree increases (Bachelor's→Master's→PhD) there were significant lower depressive symptoms (P<0.001) and higher resilience scores (P<0.001).

When the different courses were compared, there were significant differences regarding depressive symptomatology (P<0.001) and resilience scores (P<0.001). Medical students scored significantly more in the resilience scale, and Architectures/Arts, Sciences and Humanities exhibited higher risk for depression. There were no significant differences between the courses in what concerns increases in the perceived anxiety levels (P=0.196)." "Daily activities associated with lower anxiety and depressive symptoms, and higher resilience levels, were physical exercise and relaxing (both with P<0.001 in all mental health indicators). Having a job was correlated with lower depression scores (P<0.001), whereas taking care of someone sick had the opposite effect (P<0.001). Participating in extracurricular activities was associated with higher resilience scores (P=0.016).

Students maintaining contact with family were more likely to be resilient (P=0.021), less anxious (P=0.038) and reported fewer depressive symptoms (P<0.001). Contact with friends was significantly associated with lower depression symptomatology (P=0.008) and more resilience (P=0.018), but the association with anxiety was not statistically significant (P=0.656).

There was an association with better mental health indicators if the students felt satisfaction with the public health measures adopted by the school (P=0.004 for anxiety, P<0.001 for depression, P=0.003 for resilience),

by the university (P=0.001 for anxiety, P<0.001 for depression, P=0.002 for resilience), and by the government and official health entities (P=0.007 for anxiety, depression P=0.050, and resilience P=0.090). Students who had trouble accessing online classes were more likely to have increased anxiety levels (P<0.001) and depressive symptoms (P<0.001). The perception that the pandemic would hinder learning was significantly associated with a worse psychological state (P<0.001 for all psychological outcomes). Dedicating more time to study than before the pandemic was correlated with lower anxiety and depression scores (P<0.001).

Spending more time watching news was associated with feeling more anxious (P=0.004). Obtaining information from World Health Organization (WHO) or national Directorate-General of Health (NDGH) or was also associated with higher levels of anxiety (P=0.010), whereas information through social networks was associated with more depressive symptoms (P=0.007). Students who felt properly informed about the pandemic scored significantly less in the depression scale (P=0.003).

Students exposed to COVID-19 or with a relative/friend dying from COVID-19, were more likely to experience anxiety (P=0.029 and P=0.033, respectively), but there was no association with depressive symptoms (P=0.178 and P=0.613, respectively). Students who had a relative/friend infected were more likely to be more anxious (P=0.001) and to report depressive symptoms (P=0.003)."

(b) "The Portuguese version of the 9-item Patient Health Questionnaire (PHQ-9) was used to screen for symptoms of depression [9, 10]. The questionnaire is composed of 9 questions with a 4-point Likert scale ranging from 0 ("not at all") to 3 ("nearly every day"). The total score reaches a maximum of 27 and a cut-off of 10 was used to indicate the risk for depressive disorder [11].

The 9-item Resilience Evaluation Scale (RES) evaluates two underlying constructs of psychological resilience: self-confidence and self-efficacy. Each question is answered on a 5-point Likert scale ranging from "0 = totally disagree" to "4 = totally agree", with a total score ranging from 0 to 36. The sample was divided into tertiles (e.g., 3 groups of equal size divided by the 33rd and 66th percentile) based on the total scores of the RES. The first tertile (scores ≤17) was assumed to represent low psychological resilience, the

second (scores from 18 to 24) moderate psychological resilience, and the third (scores ≥25) high psychological resilience [12, 13]."

(c) Not applicable, as we did not find relevant to make the translation.

17) "Within the total sample, 183 participants were medical students. Most medical students agreed that their clinical skills (75.3%), and theoretical knowledge (50.8%) would be hindered. The majority wished to be fighting against COVID-19 along with health professional workers (60.1%) and felt their skills could have had a better use during the pandemic (54.1%).

Students felt that the pandemic increased their desire to become medical doctors (59.6%), but most did not change the specialty they consider choosing in the future (59.5%)- **Table S2.**"

Discussion

18) "Our study suggests that the COVID-19 pandemic had a significant impact in the psychological well-being of University of Porto's students. This corroborates previous studies developed during the outbreak of the virus regarding students [3, 14, 15] and general population [16, 17]. In our sample, being a female was associated with higher levels of anxiety and depression symptoms and with lower resilience. This agrees with several previous studies among the general population [17, 18], and among university students [19]. Concerning the academic degree, our results showed that higher academic degrees are associated with lower depression and higher resilience scores. This was not due to higher ages, since we did not find differences in mental health indicators when it comes to age, in agreement with previous findings [4]. We can speculate that higher educational achievement, more than age, protects students from pandemic emotional challenges. Being diagnosed with COVID-19 or having contact with someone infected was associated with higher anxiety, which is in line with several previous reports [2, 4]. Having a family member or friend diagnosed or deceased by COVID-19 or taking care of someone sick was related to poorer mental health outcomes [15, 20], which is understandable, due to the heavy emotional cost associated.

The activities linked to a better outcome in all three mental health indicators were physical exercise (and other promoting physical well-being activities) and relaxing (among other promoting psychological well-being activities). Students who had a job were more likely to be resilient and have fewer depressive symptoms. Having a job was also found to be associated with better psychological outcomes in the general population. Additionally, participating in extracurricular activities was correlated with higher resilience scores. These results obtained in this university population agree with results obtained in larger populations [18, 21, 22].

When asked about positive aspects of the pandemic, students who felt they were "able to try a new activity", had "more time spent with family", had "more time talking with friends online" or "less things to do or more time to do them" showed significant better psychological outcome. Interestingly, students who selected "none of the previous" had a worse outcome in all mental health indicators. Whereas recognizing positive aspects in the pandemic period may hint for a protective effect for psychological well-being, these results can also mean that being in a worst psychological condition may compromise the ability to perceive such aspects.

Our findings also suggest that having regular contact with family or friends is associated with better psychological outcomes. These results show the importance of preserving social interaction during the pandemic period. Having this in mind, universities could foster interaction between the students during pandemics, namely through virtual platforms.

We studied if students' perceptions regarding academic activities were related with their psychological well-being. In fact, difficulty accessing online lectures seemed to be a predisposing factor for anxiety and depression symptoms. Furthermore, students who felt the pandemic would have a negative impact in their learning and evaluation reported worst psychological condition in the evaluated parameters. Interestingly, dedicating more time to study was associated with better mental health indicators. Previous studies reported similar findings in what concerns work in non-academic contexts [18, 21] but, to the best of our knowledge, no reports specifically addressed the role of engagement in study activities at the university. These suggest that having objectives and activities to do can be a protective factor for mental health.

We found that spending more time watching news is significantly correlated with higher levels of anxiety, in agreement with previous reports [5, 18, 23]. Watching news can be a predisposing factor for anxiety and/or students who feel more anxious may have the urge to feel better informed. However, time spent watching news had no significant impact in depression scores and resilience levels. Despite this lack of association, previous studies show that students who feel more informed about the pandemic are less likely to be depressed [24]. This might be explained by the fact that perceived information is not proportionally directed to time spent watching news, which led us to believe that promoting information about the pandemics in a clear, concise and effective manner should be a priority during a pandemic. Curiously, students who reported obtaining information in WHO or DGH felt higher levels of anxiety, compared to media and social networks. An explanation for these findings is that feeling worried about the pandemic can motivate searching for information in more reliable sources of information. On the other hand, students who got the information in social networks scored significantly more in the depression scale. Students should be aware of the impact of the information sources as they may provide data in different manners. In fact, messages from media and social networks may have an affective value that can impact mental health conditions [25, 26].

Interestingly, when the different courses were compared, medical students showed significantly higher scores of resilience. Architectures/Arts, Sciences and Humanities presented higher depressive symptoms. Concerning anxiety levels, there were no significant differences between all courses. Some studies have suggested that medical students display higher levels of anxiety and depression, compared with non-medical students [14, 27]. Although our data seem to confirm high anxiety and depression scores in medical students, this also happens in students from other courses [28].

Our results show that being satisfied with the attitudes taken by the school, university and government and health agencies is associated to better psychological outcomes, which enlarges the impact of a previous study directed to the perceptions of the general population towards governmental measures [17]."

19) "Due to the sampling method, we could not ensure data's normal distribution. Therefore, we had to use non-parametric tests, which are usually less powerful than corresponding parametric tests when the normality assumption holds.

Furthermore, as we conducted a cross-sectional study, the causality is not clarified. It would be ideal to conduct a prospective study on the same group of participants.

As we conducted a self-administered online survey, we are vulnerable to have response bias.

Another limitation concerns the fact that self-reported levels of anxiety and self-perceived mental health status might not be aligned with the objective evaluation made by mental health professionals. Besides, for higher validation, we could have used standardized scales to quantify these two indicators."

20) "Concerning the academic degree, our results showed that higher academic degrees are associated with lower depression and higher resilience scores. This was not due to higher ages, since we did not find differences in mental health indicators when it comes to age, in agreement with previous findings [4]. We can speculate that higher educational achievement, more than age, protects students from pandemic emotional challenges."; "Having a family member or friend diagnosed or deceased by COVID-19 or taking care of someone sick was related to poorer mental health outcomes [15, 20], which is understandable, due to the heavy emotional cost associated."; "When asked about positive aspects of the pandemic, students who felt they were "able to try a new activity", had "more time spent with family", had "more time talking with friends online" or "less things to do or more time to do them" showed significant better psychological outcome. Interestingly, students who selected "none of the previous" had a worse outcome in all mental health indicators. Whereas recognizing positive aspects in the pandemic period may hint for a protective effect for psychological well-being, these results can also mean that being in a worst psychological condition may compromise the ability to perceive such aspects."; "Interestingly, dedicating more time to study was associated with better mental health indicators. Previous studies reported similar findings in what concerns work in non-academic contexts [18, 21] but, to the best of our knowledge, no reports specifically addressed the role of engagement in study activities at the university. These suggest that having objectives and

activities to do can be a protective factor for mental health."; "We found that spending more time watching news is significantly correlated with higher levels of anxiety, in agreement with previous reports [5, 18, 23]. Watching news can be a predisposing factor for anxiety and/or students who feel more anxious may have the urge to feel better informed. However, time spent watching news had no significant impact in depression scores and resilience levels. Despite this lack of association, previous studies show that students who feel more informed about the pandemic are less likely to be depressed [24]. This might be explained by the fact that perceived information is not proportionally directed to time spent watching news, which led us to believe that promoting information about the pandemics in a clear, concise and effective manner should be a priority during a pandemic. Curiously, students who reported obtaining information in WHO or NDGH felt higher levels of anxiety, compared to media and social networks. An explanation for these findings is that feeling worried about the pandemic can motivate searching for information in more reliable sources of information. On the other hand, students who got the information in social networks scored significantly more in the depression scale."

21) "To the best of our knowledge, this is the only study regarding the psychological impact of COVID-19 pandemic in University of Porto's students. Although these results were taken from a particular university, they may provide similar insights for other higher education students. The similarities between some of the results and other studies directed to the general population support the validity of the analysis."

Other information

22) "**Funding** No Funding."