



Research paper

Stress and associated factors among French university students under the COVID-19 lockdown: The results of the PIMS-CoV 19 study

Stéphanie Bourion-Bédès^{a,f,*}, Cyril Tarquinio^a, Martine Batt^b, Pascale Tarquinio^c,
Romain Lebreuilly^b, Christine Sorsana^b, Karine Legrand^{a,d}, Hélène Rousseau^e,
Cédric Baumann^{a,e}

^a EA4360 APEMAC (Health Adjustment, Measurement and Assessment, Interdisciplinary Approaches), University of Lorraine, 54000 Nancy, France

^b InterPsy, GRC Team, University of Lorraine, 54000 Nancy, France

^c Pierre Janet Center, 57 000 Metz, France

^d Clinical Investigation Center, INSERM, University Hospital of Nancy, 54000 Nancy, France

^e Methodology, Data Management and Statistics Unit, University Hospital of Nancy, 54000 Nancy, France

^f Centre Hospitalier de Versailles. Service Universitaire de Psychiatrie de l'Enfant et de l'Adolescent, Versailles, France

ARTICLE INFO

Keywords:

Stress

Students

Lockdown

COVID-19

ABSTRACT

Objectives: The novel coronavirus disease has caused a global public health emergency. This study aimed to investigate perceived stress levels due to the COVID-19 outbreak and explore associated factors among students under lockdown.

Methods: Sociodemographic data, living and learning conditions and existing scales of perceived stress (PSS) and social support (MSPSS) were administered to French students via an online survey. Multivariate logistic regression models were used to evaluate the association between severe perceived stress and different factors.

Results: Among 3764 university students, the average PSS score was 19.2 (SD=8.3), and 22% experienced high perceived stress. The presence of someone hospitalized for COVID-19 in one's household (OR=6, 95% CI: 2.4–14.6) and female gender (OR=2.3, 95% CI: 1.9–2.9) were the main risk factors for severe perceived stress. The following risk factors were also identified: enrollment in the arts, humanities and language program; postponement of a final examination; reduced learning time; conflicts at home and with neighbors; difficulties isolating; noise inside or outside one's home; a lack of direct outdoor access; increased alcohol and tobacco consumption; and the perceived ineffectiveness of the use of media entertainment to calm down. Friend support (OR=0.87, 95% CI: 0.82–0.93) and family support (OR=0.79, 95% CI: 0.74–0.84) and the perceived effectiveness of physical exercise (OR=0.5, 95% CI: 0.4–0.6) for calming down were protective factors.

Conclusion: These findings highlight the factors that should be taken into account to counteract students' stress and the need to focus on students during epidemics.

1. Introduction

A novel coronavirus disease, officially designated COVID-19 by the World Health Organization (World Health Organization 2019), began to spread in China in December 2019 (Zhu et al., 2020) and soon reached the level of a pandemic, affecting countries worldwide (Phelan et al., 2020). Due to this global health crisis and daily increases in the number of confirmed cases and deaths (Odriozola-Gonzalez et al., 2020), stringent public health measures were implemented to curtail the spread of COVID-19. The French government declared a population lockdown on

March 16th (Annex 1) to interrupt important chains of transmission (Sahu, 2020). The government suspended classes at every level of schooling in the country and implemented other measures, such as travel restrictions, closures of restaurants, gyms, museums and other places involving potential gatherings, which led students to live in self-isolation and protect themselves from any person-to-person contact. The lockdowns implemented in various countries led to a notable emotional impact on the population worldwide, with people experiencing important symptoms of anxiety, depression and stress (Bourion-Bédès et al., 2020; Song, 2020; Wang et al., 2020a; Wang et al.,

* Corresponding author at: EA4360 APEMAC, 54000 Nancy, France

E-mail address: steph_bedes@yahoo.fr (S. Bourion-Bédès).

<https://doi.org/10.1016/j.jad.2021.01.041>

Received 22 November 2020; Received in revised form 12 January 2021; Accepted 14 January 2021

Available online 18 January 2021

0165-0327/© 2021 Elsevier B.V. All rights reserved.

2020b; Wang and Zhao, 2020). A previous review of the literature reported a prevalence of symptoms of anxiety and depression of 16 to 28% and a prevalence of self-reported stress of 8% (Rajkumar, 2020). Considering the usual high prevalence of mental disorders in university students before the epidemic (Auerbach et al., 2016), it was reasonable to expect that the COVID-19 lockdown would cause a notable impact on this community because of the challenges commonly associated with the transition to adulthood and the frequent economic and material difficulties in this vulnerable population (Husky et al., 2020). As a result of the lockdown and the closure of schools and universities, students faced stress, depression and anxiety due to changes in teaching conditions (Asanov et al., 2021; De Oliveira Araújo et al., 2020) and effects on their social network lives, such as friendships, group study habits and emotional support (Elmer et al., 2020). Although knowledge on the overall impact on the mental health of students facing this contagious disease is scarce, some findings on stress levels were published. A recent study of French university students revealed that 61.6% of students experienced moderate to severe life stress, particularly students who remained in their usual places of residence compared to students who relocated for the lockdown (Husky et al., 2020). A study of students and workers at a Spanish university reported moderate to extreme anxiety scores in 28.14% of the respondents, with higher stress scores observed in students than the different groups of employees and with higher scores for students in the arts and humanities and the social sciences and law than students from engineering and architecture (Odrizola-Gonzalez et al., 2020). Notably, changes in multiple mental health indicators and dimensions of social networks were studied in two cohorts of Swiss undergraduate students before and during the lockdown using longitudinal data collected since 2018. Students' levels of stress, anxiety, and depressive symptoms worsened compared to levels before the crisis, and female students had worse mental health trajectories. COVID-19-specific worries, isolation from social networks, a lack of interaction and emotional support and physical isolation were associated with negative mental health trajectories (Elmer et al., 2020).

As of October 28, 2020, 1,165,278 confirmed cases and 35,018 deaths attributable to this disease had been reported in France, which made France the country with the fifth largest number of people affected by this pandemic. The disease is still spreading elsewhere, and knowledge of the sociodemographic characteristics, living and learning conditions and health status characteristics associated with a high level of stress in French students under lockdown due to the COVID-19 outbreak is of interest. This knowledge offers the opportunity to implement suggestions or recommendations at local and regional levels to combat the effects of the pandemic on students' mental health. Based on this perspective, the present study investigated the stress levels of students under lockdown from the Grand Est region, which has been the third most severely affected region by the disease, and examined the associated factors that should be taken into account to counteract students' stress.

2. Methods

2.1. Participants and procedure

This study was a cross-sectional analysis of data from the observational Feelings and Psychological Impact of the COVID-19 Epidemic among Students in the Grand Est Area (PIMS-CoV19) study. Every student from the University of Lorraine and the Sciences Po College located in Nancy, Grand Est region, France, was eligible to participate in the study. Students were recruited to participate in an anonymous online survey from May 7 to May 17, 2020. The Grand Est area was most affected by COVID-19 in the incidence of COVID-19 cases, with 19.6 cases per 100,000 inhabitants during the survey period. The web-based survey took approximately 20 minutes to complete and included questions about sociodemographic data, living conditions, health status measures and concerns about the threat to health posed by COVID-19.

All data were obtained at the time of the online survey.

2.2. Measures

2.2.1. Stress

The Perceived Stress Scale-10 (PSS-10) was used to measure stress. The PSS-10 was derived from the original 14-item form developed by Cohen, Kamarck and Mermelstein to assess "the degree situations in one's life appraised as stressful" (Cohen et al., 1983). It is comprised of 10 items, with each item reflecting the frequency of an indicator of stress over the past month. The items are rated on a 5-point scale ranging from 0 "never" to 4 "very often". The item scores were summed following the instructions for scoring the PSS. The total score ranged from 0 to 40, with higher scores indicating higher levels of perceived stress. Total mean scores of 0-13 indicate low stress, scores of 14-26 indicate moderate stress, and scores of 27-40 indicate high stress (AlAteeq et al., 2020). The scale has been used in many studies to assess stress in university students (Cavallo et al., 2016; Manzar et al., 2019). The French version of the scale was previously confirmed to have good internal consistency, with a Cronbach's alpha coefficient of 0.83 and good reliability (Lesage et al., 2012).

2.2.2. Self-perceived social support

Self-perceived social support was measured using the 12-item Multidimensional Scale of Perceived Social Support (MSPSS). The original version yielded valid clinical assessments of perceived social support among students (Dahlem et al., 1991). It assesses social support from three sources: family, friends and significant others (Zimet et al., 1988). The students were asked to indicate their level of agreement with each item on a 7-point Likert scale ranging from 1 ("very strongly disagree") to 7 ("very strongly agree"). The total score of each dimension ranges from 1 to 7, with higher scores indicating higher perceived social support. The French version of the MSPSS was used, and it was previously shown to have good internal reliability and reproducibility (Denis et al., 2015).

2.2.3. Sociodemographic data and other characteristics

Data on the students' age, gender, living arrangements, home location and academic information, including academic program and scholarship status, were obtained. Information on the students' living and learning conditions, changes in consumption of psychoactive substances, preventive behaviors for COVID-19 and the presence of a relative or acquaintance infected with COVID-19 was also collected.

2.3. Statistical analysis

2.3.1. Descriptive analyses

The mean (\pm standard deviation) or median, as appropriate, was calculated for the continuous variables, and the number or percentage was calculated for the categorical variables.

2.3.2. Bivariate and multivariate analyses

Logistic regression models were used to determine which variables were associated with a high level of perceived stress. Therefore, the probability modeled was a PSS-10 score higher than 26 (AlAteeq et al., 2020). The influence of sociodemographic characteristics, learning and teaching conditions, living conditions, concerns about the health threat posed by COVID-19 and the self-perceived social support scores on the PSS-10 were investigated. Variables were identified as relevant when they were significant in bivariate analyses at the 10% threshold. A multivariable logistic regression model was used to retain factors at a significance level of 0.05. The goodness of fit was assessed using the model determination coefficient (R^2) and the percentage that was predicted correct by the model. Pearson correlation, Phi coefficients and variation inflation factors ($VIF < 10$) were calculated to verify the lack of correlation and multicollinearity (Hair et al., 1995). Hosmer and

Table 1

Sociodemographic and learning characteristics of the student sample population under the lockdown. (N = 3764).

Characteristic	Full sample N	%/mean (SD)
Age	3756	21.7 (4.0)
Gender (missing=11)		
Male	1097	29.2
Female	2656	70.8
Financial aid programs		
None	2232	59.3
Scholarship	1532	40.7
Student part-time job		
None	2631	69.9
Activity interrupted during the lockdown	536	14.2
Activity increased during the lockdown	288	7.7
No change during the lockdown	309	8.2
<i>Learning conditions</i>		
Academic program (missing=14)		
Sports, medical sciences, science and technology	2186	58.1
Law, economics, management	645	17.1
Arts, humanities, languages	318	8.5
Social and human sciences	601	16.0
Online teaching delivery		
No	775	20.6
Partial	1619	43.0
Total	1370	36.4
Time spent working at home		
No change	1099	29.2
Increased time	756	20.1
Reduced time	1909	50.7
Postponement of final examination (Yes)	515	13.7

Abbreviation: SD, standard deviation

Lemeshow test allowed the comparison and selection of the best multivariable model. Analyses were performed using SAS 9.4 (SAS Inst., Cary, NC, USA).

3. Results

3.1. Sociodemographic and learning characteristics

The sociodemographic and learning characteristics of the 3764 students are presented in Table 1. Most participants were female (70.8%), and the participants' mean age was 21.7 years old (SD = 4.0). The participants were mostly from science faculties, including sport sciences, science and technology and medical sciences (58.1%), followed by students of law, economy and management (17.2%) and the social sciences (16%). Of the 3764 students, 40.7% reported being in a financial aid program, as scholarship students, and 14.2% reported that their student part-time jobs were interrupted due to the lockdown. The time spent working at home decreased for 50.7% of the students, and less than a quarter of the students (20.6%) did not receive online teaching. With the lockdown, 13.7% reported the postponement of a final examination.

3.2. Living conditions and behavioral characteristics

The results of the students' living conditions and behavioral characteristics are reported in Table 2. A total of 13.7% of the students in the sample lived alone, and 20.2% lived with friends or a partner, and 66.1% lived with their parents or a family member during the lockdown. More than half lived (59%) in urban areas, and 17.2% reported having no access to outdoor areas. Of the 3764 participants, 28.3% reported conflicts with other persons where they spent the lockdown. Before the lockdown, 17.7% reported consuming alcohol two or more times per week, and alcohol use increased under lockdown for 13.7% of the students. Media entertainment (97.9%), physical exercise (82.7%) and manual activities (51.0%) were the most used means to relieve distress.

Table 2

Living conditions and lifestyles of the student sample population under the lockdown (N = 3764).

	Full sample N = 3764 N	%
<i>Living conditions</i>		
Home location (missing=27)		
Urban area	2206	59.0
Rural area	1531	41.0
Living arrangements (missing=6)		
Alone	514	13.7
With friends/partner	758	20.2
With parents	2486	66.1
Access to a private outside space		
No access	645	17.2
Private balcony, courtyard or terrace	580	15.5
Private domestic garden	2251	60.1
Courtyard or garden for collective use	269	7.2
Difficulty isolating at home		
Yes	945	25.1
No	2819	74.9
Tensions and conflicts at home		
Yes	1066	28.3
No	2698	71.7
Noises outside the residence		
Yes	878	23.3
No	2886	76.7
Noises inside the residence		
Yes	753	20.0
No	3011	80.0
Someone at home had COVID-19		
No	3180	84.5
Confirmed and hospitalized cases	27	0.7
Confirmed and non-hospitalized cases	139	3.7
Suspected cases	418	11.1
Relative or acquaintance had COVID-19		
No	1864	49.5
Confirmed and hospitalized cases	452	12.0
Confirmed and non-hospitalized cases	849	22.6
Suspected cases	599	15.9
<i>Lifestyle Factors</i>		
Alcohol consumption (missing=1)		
None	1280	34.0
No change	642	17.1
Increased consumption	514	13.7
Reduced consumption	1327	35.3
Tobacco use (missing=2)		
None	3148	83.7
No change	113	3.0
Increased use	267	7.1
Reduced use	234	6.2

Fifty-nine students reported substance use as a means to cope with the negative conditions they were experiencing. One-third of the students (34.6%) reported having a relative or acquaintance who was infected with COVID-19, and 4.4% were living in the same place of residence as someone who had been infected by COVID-19.

Table 3

Stress and social support scores of the students under the lockdown.

	Full sample N = 3764 N	%/Mean (SD)
PSS-10- total score	3764	19.2 (8.3)
Low stress (0-13)	991	27.3
Moderate stress (14-26)	1946	51.7
Severe stress (27-40)	827	22.0
MSPSS-total score	3764	5.5 (1.1)
MSPSS-subscores		
Family	3764	5.2 (1.5)
Friend	3764	5.5 (1.3)
Significant other	3764	5.7 (1.3)

Abbreviation: SD, standard deviation; PSS-10, 10-item Perceived Stress Scale; MSPSS, Multidimensional Scale of Perceived Social Support

3.3. Stress and social support under the lockdown

The results of the PSS-10 and MSPSS are presented in Table 3. The mean PSS-10 score was 19.2 (SD=8.3), the median score was 19, and the interquartile range was 13–26. In general, 51.7% of the students had moderate stress, and 22% had high stress. The mean MSPSS total score was 5.5 (SD=1.1). The mean scores for support from family, friends and significant others were 5.2 (SD=1.5), 5.5 (SD=1.3) and 5.7 (SD=1.3), respectively.

3.4. Factors associated with high perceived stress

Table 4 shows the results of the bivariate and multivariable analyses. No correlation was observed between the explanatory variables (all <0.5). VIFs were consistently < 2, which indicated a lack of multicollinearity. The model determination coefficient (R^2) was 0.3, and the percentage predicted correct was 78.9%. Female gender was associated with a high level of perceived stress (OR=2.3, 95% CI: 1.9–2.9). Among the learning conditions, the following factors were associated with a high level of stress: enrollment in the arts, humanities, and languages program (OR=1.6, 95% CI: 1.2–2.1); postponement of a final examination (OR=1.6, 95% CI: 1.3–2.1); and decreased learning time (OR=1.9,

Table 4

Factors associated with severe stress during the COVID-19 lockdown (N= 3679).

	Bivariate regression, analysis			Multivariate logistic regression analysis $R^2 = 0.28$, H&L=0.12		
	OR	95% CI	P-value	OR	95% CI	P-value
Age (ref: <median age)	0.9	0.9–1.0	0.026			
Gender (female vs. male)	2.6	2.1–3.2	<0.0001	2.3	1.9–2.9	<0.0001
Financial aid program (ref: scholarship vs. none)	1.2	1.0–1.4	0.015			
Academic program (ref: sports, med. sciences, science and technology)			<0.0001			0.0027
Law, economics, management	1.2	0.9–1.4		1.0	0.8–1.3	
Arts, humanities, languages	2.3	1.8–3.0		1.6	1.2–2.1	
Social and human sciences	1.3	1.1–1.6		0.8	0.6–1.1	
Online teaching delivery (ref: none)			0.0002			
Partial online teaching	1.1	0.9–1.4				
Total online teaching	0.8	0.6–1.0				
Time spent working at home (ref: no change)			<0.0001			<0.0001
Increased time	1.2	1.0–1.6		1.2	0.9–1.5	
Reduced time	2.1	1.7–2.6		1.9	1.5–2.3	
Postponement of final examination (Yes vs. No)	1.6	1.3–2.0	<0.0001	1.6	1.3–2.1	<0.0001
Home location (ref: urban vs. rural area)	1.0	0.8–1.2	0.91			
Access to a private outside space (ref: Private domestic garden,)			<0.0001			0.0004
Balcony, courtyard or terrace	1.4	1.1–1.7		1.4	1.1–1.8	
Courtyard or garden for collective use	1.0	0.8–1.4		1.1	0.8–1.7	
No access	1.5	1.2–1.8		1.6	1.3–2.1	
Difficulty isolating at home (Yes vs. No)	2.7	2.3–3.2	<0.0001	1.4	1.2–1.7	0.0009
Tensions and conflicts at home (Yes vs. No)	3.0	2.5–3.5	<0.0001	1.8	1.5–2.2	<0.0001
Noises outside the residence (Yes vs. No)	2.1	1.8–2.5	<0.0001	1.5	1.2–1.8	0.0004
Noises inside the residence (Yes vs. No)	2.6	2.2–3.1	<0.0001	1.4	1.1–1.7	0.008
Someone at home had COVID-19 (ref: no)			<0.0001			0.0009
Confirmed and hospitalized cases	5.6	2.6–12.1		6.0	2.4–14.6	
Confirmed and non-hospitalized cases	1.4	1.0–2.1		1.3	0.8–2.0	
Suspected cases	1.5	1.2–1.9		1.1	0.9–1.5	
	Bivariate regression, analysis			Multivariate logistic regression analysis $R^2 = 0.28$, H&L=0.12		
	OR	95% CI	P-value	OR	95% CI	P-value
Relative or acquaintance had COVID-19 (ref: no)			<0.0001			0.053
Confirmed and hospitalized cases	1.9	1.5–2.4		1.3	1.0–1.8	
Confirmed and non-hospitalized cases	1.5	1.2–1.8		1.3	1.0–1.6	
Suspected cases	1.4	1.1–1.8		1.2	0.9–1.6	
Alcohol consumption (ref: Reduced consumption)			<0.0001			0.026
No change	1.1	0.8–1.4		1.2	0.9–1.5	
Increased consumption	2.0	1.6–2.5		1.5	1.1–2.0	
None	1.4	1.2–1.7		1.2	0.9–1.5	
Tobacco use (ref: none)			<0.0001			0.022
No change	1.3	0.8–1.9		1.3	0.8–2.1	
Increased use	2.0	1.6–2.7		1.6	1.2–2.3	
Reduced use	1.1	0.8–1.5		1.1	0.8–1.6	
MSPSS-subscores						
Family	0.7	0.6–0.7	<0.0001	0.79	0.74–0.84	<0.0001
Friend	0.8	0.7–0.8	<0.0001	0.87	0.82–0.93	<0.0001
Significant other	0.8	0.8–0.9	<0.0001			
Media entertainment (ref: not used) *			<0.0001			0.0024
1-Ineffective	4.6	2.2–9.7		3.6	1.6–8.2	
Reading entertainment (ref: not used) *			<0.0001			0.0003
1-Ineffective	2.2	1.6–3.1		1.5	1.0–2.3	
2-Nearly ineffective	1.5	1.5–2.0		1.6	1.2–2.1	
Physical exercise (ref: not used) *			<0.0001			<0.0001
4- Effective	0.6	0.5–0.8		0.5	0.4–0.6	0.5
5-Very effective	0.4	0.3–0.5		0.4	0.3–0.6	0.4

Abbreviations: OR, odds ratio: the probability of a PSS-10 score >26; OR<1, decreased probability of PSS-10 score > 26; OR>1, increased probability of PSS-10 score > 26; SD, standard deviation; MSPSS, Multidimensional Scale of Perceived Social Support.

* For these variables, the p-value is for the global comparison of each modality of effectiveness versus if this strategy was not used. Only significant ORs (95% CIs) are shown.

95% CI: 1.5–2.3). Compared to students who had access to a private garden, students without direct access to outside gardens, terraces or balconies and students with access only to balconies, terraces or courtyards had a higher probability of a high level of perceived stress (OR=1.6, 95% CI: 1.3–2.1; OR=1.4, 95% CI: 1.1–1.8, respectively).

Difficulties isolating in one's home (OR=1.4, 95% CI: 1.2–1.7), indoor noise in one's home (OR=1.4, 95% CI: 1.1–1.7), noise outside the home (OR=1.5, 95% CI: 1.2–1.8), conflicts with the occupants of the dwelling (OR=1.8, 95% CI: 1.5–2.2) and conflicts with neighbors (OR=1.5, 95% CI: 1.2–1.7) were risk factors for stress. Having someone in one's household affected by COVID-19 was the strongest risk factor for high perceived stress (OR=6, 95% CI: 2.4–14.6). Compared to students who declared no tobacco consumption, students who reported increased tobacco consumption had a higher probability of a high level of stress. (OR=1.6 95% CI: 1.2–2.3). Students who reported increased alcohol consumption had a higher probability of a high level of stress (OR=1.5, 95% CI: 1.1–2.0) compared to students who reduced alcohol consumption. The self-perceived ineffectiveness of media entertainment (OR=3.6, 95% CI: 1.6–8.2) and the self-perceived ineffectiveness of reading (OR=1.5, 95% CI: 1.1–2.3) to calm down were risk factors for stress. However, the perception of physical exercise as a very effective means to calm down was a protective factor against stress (OR=0.5, 95% CI: 0.4–0.6). In terms of social support for students under lockdown, family support (OR=0.79, 95% CI: 0.74–0.84) and friend support (OR=0.87, 95% CI: 0.82–0.93) were protective factors against stress.

4. Discussion

The present study was performed during a critical time period when the population was under lockdown, which is of public health significance for a student population at an increased risk of mental health problems (Debowska et al., 2020). Our findings highlight that most of the participants experienced moderate to severe stress levels due to COVID-19. Notably, the observed prevalence of high stress was lower than a previous study of Polish students (Rogowska et al., 2020) but consistent with previous international studies of students during COVID-19, which reported a prevalence of high stress of 30.2% and a prevalence of moderate stress of 55%, also using the PSS-10 (AlAteeq et al., 2020). The mean PSS score endorsed by the participating students was comparable to American students (Son et al., 2020) and lower than the mean score of a subgroup of university students in Saudi Arabia (AlAteeq et al., 2020). These findings must be taken into account because the stress produced by these dramatic changes faced by young university students may lead to symptoms of depression or result in a state of anxiety that could later lead to depression (Rodriguez-Hidalgo et al., 2020). To the best of our knowledge, this study is one of the first studies to attempt to understand the association between severe perceived stress and sociodemographic characteristics, health status characteristics and living and learning conditions during the lockdown. Identification of the risk and protective factors is critical for the development of new guidelines and targeted interventions to support students, as previously suggested (Chang et al., 2020). Consistent with previous findings, female students appeared to be at higher risk of negative mental health consequences than male students (Cao et al., 2020) because females are more emotional (Aslan and Pekince, 2020).

Other sources of stress identified in this study included learning conditions, such as enrollment in the arts, humanities and languages program, the postponement of a final examination, and reduced learning time. A recent study reported that students from the social sciences, law and arts and humanities fields were more affected than students from engineering and architecture (Odriozola-Gonzalez et al., 2020). The difficulties of teaching some courses online, such as fine arts, art, and music courses, may place students under excessive stress, for example, due to the uncertainty about the final examination, that causes students to worry about the future (Sahu, 2020). Increased tobacco and alcohol use was associated with the students' stress. The factors underlying this

association are under discussion, and the cross-sectional study design precludes causal conclusions. However, our findings revealed that some participants used psychoactive substances to help cope with stress during the pandemic. Some students relied on negative coping methods, such as drinking and smoking, and others engaged in relaxing hobbies, including physical exercise or reading, for self-management (Ye et al., 2020). Although previous national results (Husky et al., 2020) showed mostly no reported changes in alcohol use in student samples, our findings indicated increased alcohol use for 13.7% of the students and decreased consumption for 35.3%. It remained possible to purchase alcohol at any supermarket in France for the duration of the lockdown despite the closures of restaurants, bars and nightclubs. Among the living conditions, conflicts at home, difficulties isolating and noisy environments added to the students' stress, regardless of their place of residence. More than one-third of the students in our sample changed residences before the lockdown began and were living with their parents. This relocation to another residence with different daily relationships with family may have increased conflicts but likely offered open access to an exterior space, such as a yard or garden. Students who had no access to an outdoor space experienced a high level of stress. The results also showed that having relatives or acquaintances at home who had been infected with COVID-19 and hospitalized was clearly the main risk factor for the students' stress. This result is not surprising, because at the time the online survey was performed, the daily total number of confirmed cases reached 483 coronavirus-related deaths/day on May 17th. The novelty of the virus itself, the uncertainty of what would happen to people who contracted the disease and the question of when the disease would be entirely controlled may have induced stress among the students. The development of resilience may offer a feasible intervention, and the benefits of this preparation will likely extend beyond the pandemic, with strengthened resilience aiding in the transition from being a student to being an adult earning a living (O'Byrne et al., 2020). As expected (Ye et al., 2020), family members and friends were good resources from whom the students could seek help during the lockdown. These observations support the need to develop interventions to support students who are isolated and potentially at risk. These interventions could include digital forms of study groups, peer group sessions and psychological interventions.

The study has some limitations and strengths. As a limitation, an online survey method was used, which could have contributed to some bias in the study results. First, selection bias may exist because only students who were familiar with web-based surveys would have responded. This selection bias could have led to an overestimation of the prevalence of students with high levels of stress. Second, self-reported data may be subject to social desirability bias and result in under-reporting, particularly data related to the consumption of products or the practice of physical activity during the lockdown. Third, the study sample was from a single region, and it is difficult to generalize our results to all French university students. However, given that all students stayed at home under the lockdown, the reasonable generalizability of these findings may be expected. Larger surveys should be performed to increase the generalizability of the findings. Last, the typology of the study (observational) and its transversal design did not allow us to draw causal conclusions. However, some of the associations highlighted and discussed make sense. Among the strengths, the large sample size allowed us to perform a robust analysis and extract solid tendencies. It offered valuable information that helped gain insight into students' feelings in possible future lockdowns due to a second wave.

Because of the increased curve of confirmed COVID-19 cases at the time of our study and of this writing, we suggest that university students' mental health should be carefully monitored during this health crisis and that it is essential to assess students' stress levels to provide psychological services that are oriented and adapted to these circumstances. These results may be used as a baseline and highlight the need for the development of online stress management programs to improve stress and adaptive coping strategies to counteract the potential negative

effects of COVID-19 on individuals' mental health. Universities and families must pay more attention to the vulnerable university student community, and researchers should attempt to assess the impact of COVID-19 in other vulnerable populations, such as children and adolescents.

5. Patient and public involvement

All participants received detailed information on the purpose of the study and provided online informed consent to participate. The survey was anonymous to ensure the confidentiality and reliability of the data. All procedures were performed in accordance with the principles of the Declaration of Helsinki.

Contributors

SB-B, CB, MB and CT conceived of the study protocol with input from KL and HR. All authors organized the data collection. HR performed the statistical analysis with support from CB. SB-B and CB interpreted the data with support from HR. SB-B wrote the first draft of the manuscript. All authors read and approved the final manuscript. The corresponding author attests that all listed authors meet authorship criteria and that no other authors meeting the criteria have been omitted. SB-B and CB act as guarantors.

Funding

No funding.

Data sharing

No additional data available.

Declaration of Competing Interest

The authors declare that they have no competing interests.

Acknowledgments

The authors gratefully acknowledge Professor Pierre Mutzenhardt, President of the University of Lorraine, Mr. Frédéric Villiéras, Vice-President Research of the University of Lorraine, Mr. François Laval, Director of the Nancy Campus Sciences Po Paris, and all of the students from who participated in this study.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jad.2021.01.041.

References

- AlAteeq, D.A., Aljhani, S., AlEesa, D.J., 2020. Perceived stress among students in virtual classrooms during the COVID-19 outbreak in KSA. *Taibah Univ. Med. Sci.* 15 (5), 398–403. <https://doi.org/10.1016/j.tjmed.2020.07.004>. OctEpub 2020 Aug 1.
- Asanov, I., Flores, F., McKenzie, D., Mensmann, M., Schulte, M., 2021. Remote-learning, time-use, and mental health of Ecuadorian high-school students during the COVID-19 quarantine. *World Dev.* 138, 105225 <https://doi.org/10.1016/j.worlddev.2020.105225>. FebEpub 2020 Oct 22.PMID: 33110286.
- Aslan, H., Pekince, H., 2020. Nursing students' views on the COVID-19 pandemic and their perceived stress levels. *Perspect Psychiatry Care*. <https://doi.org/10.1111/ppc.12597>. 2020 Aug 17:10.1111/ppc.12597Online ahead of print.
- Auerbach, R.P., Alonso, J., Axinn, W.G., et al., 2016. Mental disorders among college students in the world health organization world mental health surveys. *Psychol. Med.* 46, 2955–2970.
- Bourion-Bédès, S., Tarquinio, C., Batt, M., Tarquinio, P., Lebreuilly, R., Sorsana, C., Legrand, K., Rousseau, H., Baumann, C., 2020. Psychological impact of the COVID-19 outbreak on students in a French region severely affected by the disease: results of the PIMS-CoV 19 study. *Psychiatry Res.* 5, 113559 <https://doi.org/10.1016/j.psychres.2020.113559>. NovOnline ahead of print.PMID: 33189368.
- Cao, W., Fang, Z., Hou, G., et al., 2020. The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Res.* 287, 112934.
- Cavallo, P., Carpinelli, L., Savarese, G., 2016. Perceived stress and bruxism in university students. *BMC Res. Notes* 9 (1), 514. <https://doi.org/10.1186/s13104-016-2311-0>. Dec 21.
- Chang, J., Yuan, Y., Wang, D., 2020. Mental health status and its influencing factors among college students during the epidemic of COVID-19. *Nan Fang Yi Ke Da Xue Xue Bao* 40 (2), 171–176. <https://doi.org/10.12122/j.issn.1673-4254.2020.02.06>. Feb 29.
- Cohen, S., Kamarck, T., Mermelstein, R., 1983. A global measure of perceived stress. *Health Soc. Behav. Dec.* 24 (4), 385–396.
- Dahlem, N.W., Zimet, G.D., Walker, R.R., 1991. The multidimensional scale of perceived social support: a confirmation study. *J. Clin. Psychol.* 47, 756–761.
- Debowska, A., Horeczy, B., Boduszek, D., Dolinski, D., 2020. A repeated cross-sectional survey assessing university students' stress, depression, anxiety, and suicidality in the early stages of the COVID-19 pandemic in Poland. *Psychol. Med.* Oct. 2, 1–4. <https://doi.org/10.1017/S003329172000392X>. Online ahead of print.
- Denis, A., Callahan, S., Bouvard, M., 2015. Evaluation of the French version of the multidimensional scale of perceived social support during the postpartum period. *Matern Child Health J.* 19, 1245–1251.
- De Oliveira Araújo, F.J., de Lima, L.S.A., et al., 2020. Impact of Sars-Cov-2 and its reverberation in global higher education and mental health. *Psychiatry Res.* 288, 112977.
- Elmer, T., Mephram, K., Stadtfeld, C., 2020. Students under lockdown: comparisons of students' social networks and mental health before and during the COVID-19 crisis in Switzerland. *PLoS One* 15 (7), e0236337. <https://doi.org/10.1371/journal.pone.0236337>. Jul 23eCollection 2020.PMID: 32702065.
- Hair Jr., J.F., Anderson, R.E., Tatham, R.L., Black, W.C., 1995. *Multivariate Data Analysis*, 3rd ed. Macmillan, New York.
- Husky, M.M., Koyess-Masfety, V., Swendsen, J.D., 2020. Stress and anxiety among university students in France during Covid-19 mandatory confinement. *Compr Psychiatry*. Oct. 102, 152191 <https://doi.org/10.1016/j.comppsy.2020.152191>.
- Lesage, F.X., Berjot, S., Deschamps, F., 2012. Psychometric properties of the French versions of the Perceived Stress Scale. *Int. J. Occup. Med. Environ. Health* 25 (2), 178–184. <https://doi.org/10.2478/S13382-012-0024-8>. JunEpub 2012 Apr 19.
- Manzar, M.D., Salahuddin, M., Peter, S., Alghadir, A., Anwer, S., Bahammam, A.S., Pandi-Perumal, S.R., 2019. Psychometric properties of the perceived stress scale in Ethiopian university students. *BMC Public Health* 19 (1), 41. <https://doi.org/10.1186/s12889-018-6310-z>. Jan 9.
- O'Byrne, L., Gavin, B., McNicholas, F., 2020. Medical students and COVID-19: the need for pandemic preparedness. *J. Med. Ethics*. <https://doi.org/10.1136/medethics-2020-106353>. Epub 2020 Jun 3.
- Odriozola-González, P., Planchuelo-Gómez, Á., Irurtia, M.J., de Luis-García, R., 2020. Psychological effects of the COVID-19 outbreak and lockdown among students and workers of a Spanish university. *Psychiatry Res.* Aug 290, 113108. <https://doi.org/10.1016/j.psychres.2020.113108>. Epub 2020 May 19.PMID: 32450409.
- Phelan, A.L., Katz, R., Gostin, L.O., 2020. The novel coronavirus originating in Wuhan, China: challenges for global health governance. *JAMA*. <https://doi.org/10.1001/jama.2020.1097>.
- Rajkumar, R.P., 2020. COVID-19 and mental health: a review of the existing literature. *Asian J. Psychiatry* 52, 102066. <https://doi.org/10.1016/j.ajp.2020.102066>. AugEpub 2020 Apr 10.PMID: 32302935.
- Rodríguez-Hidalgo, A.J., Pantaleón, Y., Dios, I., Falla, D., 2020. Fear of COVID-19, stress, and anxiety in university undergraduate students: a predictive model for depression. *Front. Psychol.* 11, 591797 <https://doi.org/10.3389/fpsyg.2020.591797>. Nov 5eCollection 2020.PMID: 33224080.
- Rogowska, A.M., Kuśnierz, C., Bokszczanin, A., 2020. Examining anxiety, life satisfaction, general health, stress and coping styles during COVID-19 pandemic in polish sample of university students. *Psychol. Res. Behav. Manag.* 13, 797–811. <https://doi.org/10.2147/PRBM.S266511>, 2020 Sep 28eCollection 2020.
- Sahu, P., 2020. Closure of universities due to coronavirus disease 2019 (COVID-19): impact on education and mental health of students and academic staff. *Cureus* 12 e7541.
- Son, C., Hegde, S., Smith, A., Wang, X., Sasangohar, F., 2020. Effects of COVID-19 on college students' mental health in the United States: interview survey study. *J. Med. Internet Res.* PMID: 32805704.
- Song, M., 2020. Psychological stress responses to COVID-19 and adaptive strategies in China. *World Dev.* 136, 105107 <https://doi.org/10.1016/j.worlddev.2020.105107>. DecEpub 2020 Jul 24.PMID: 32834388.
- Wang, C., Pan, R., Wan, X., et al., 2020a. Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *Int. J. Environ. Res. Public Health* 17, 1729.
- Wang, C., Zhao, H., 2020. The Impact of COVID-19 on anxiety in Chinese university students. *Front. Psychol.* 11, 1168. <https://doi.org/10.3389/fpsyg.2020.01168>. May 22eCollection 2020.
- Wang, Z.H., Yang, H.L., Yang, Y.Q., Liu, D., Li, Z.H., Zhang, X.R., Zhang, Y.J., Shen, D., Chen, P.L., Song, W.Q., Wang, X.M., Wu, X.B., Yang, X.F., Mao, C., 2020b. Prevalence of anxiety and depression symptom, and the demands for psychological knowledge and interventions in college students during COVID-19 epidemic: a large cross-sectional study. *J. Affect Disord.* 275, 188–193. <https://doi.org/10.1016/j.jad.2020.06.034>. Oct 1Epub 2020 Jul 2.PMID: 32734907.
- World Health Organization. 2019-nCoV outbreak is an emergency of international concern. <http://www.euro.who.int/en/healthtopics/emergencies/pages/news/news/2020/01/2019-ncov-outbreak-is-an-emergency-of-international-concern>.

Ye, Z., Yang, X., Zeng, C., Wang, Y., Shen, Z., Li, X., Lin, D., 2020. Resilience, social support, and coping as mediator between COVID-19-related stressful experiences and acute stress disorder among college students in China. *Appl. Psychol. Health Well Being*. <https://doi.org/10.1111/aphw.12211>. Jul 15:10.1111/aphw.12211Online ahead of print.PMID: 32666713.

Zhu, N., Zhang, D., Wang, W., et al., 2020. A novel coronavirus from patients with pneumonia in China, 2019. *N Engl. J. Med.* 382, 727–733.

Zimet, G.D., Dahlem, N.W., Zimet, S.G., et al., 1988. The multidimensional scale of perceived social support. *J. Pers. Assess* 52, 30–41.