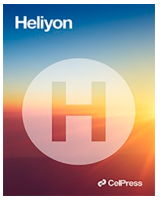
Heliyon 11 (2025) e41957

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon



Research article

Symptoms of anxiety and depression among health and social science students: A multicenter study

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ARTICLE INFO

Keywords:
University students
Anxiety
Depression
Mental health
Cross-sectional study

ABSTRACT

Background: The mental health of university students is a global concern, with high rates of depression and anxiety that need to be addressed.
Aim: We aimed to compare the mental health of Portuguese, Swedish and German university students in the health and social sciences following the Covid-19 pandemic and to analyze the factors associated with depressive and anxious symptoms in each country.
Methods: A cross-sectional study with a sample of students from Portugal, Germany and Sweden was conducted. Data from online questionnaires, including a sociodemographic and clinical questionnaire, the Patient Health Questionnaire (PHQ-9), the General Anxiety Disorder (GAD-7) and the MHI-5 (Mental Health Inventory) was collected from October to December 2022.
Results: The sample was composed of 1670 university students. The prevalence of mild to severe depressive symptoms was 72.7 % in Germany, 62.9 % in Sweden, and 60.3 % in Portugal and the prevalence of mild to severe anxiety symptoms was 78.6 % in Portugal, 73.7 % in Germany, and 66.9 % in Sweden. Being a female student, having a previous mental health disorder diagnosis, and poor academic performance were associated with higher severity of depression and anxiety symptoms in all three countries. Country-specific factors associated with more depressive and/or anxiety symptoms were younger age, smoking, low socioeconomic level and living away from home. Swedish students who do not consume alcohol had more anxiety symptoms and German students who do not consume alcohol had more depressive symptoms.
Conclusion: The high prevalence of depressive and anxiety symptoms among students in the three countries highlights the need to address modifiable factors that contribute to this mental health burden. Our results, which are in line with international trends, underline the need for policy reforms that target the main determinants of mental health, in particular by improving socio-

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https://doi.org/10.1016/j.heliyon.2025.e41957
Received 23 May 2024; Received in revised form 2 January 2025; Accepted 13 January 2025
Available online 15 January 2025

economic conditions. Addressing these factors could play a crucial role in improving mental health outcomes in this population.

1. Introduction

The prevalence of mental disorders has been increasing in university students worldwide, and accordingly, help-seeking is becoming increasingly common [1]. The World Health Organization's (WHO) "World Mental Health International College Student" study of 19 universities in eight countries (Australia, Belgium, Germany, Mexico, Northern Ireland, South Africa, Spain, and the United States) reported that 35 % of first-year college students met criteria for at least one common psychiatric disorder (e.g., major depression, mania/hypomania, generalized anxiety disorder, panic disorder, alcohol use disorder, and substance use disorder) [1]. In the *World mental health report: Transforming mental health for all*, the WHO recognizes young adults as a risk group for mental health problems and the importance of investing in universities [2]. These rates reflect the significant challenges that the transition to university presents for students [3], during which some students describe experiencing a loss of their identity and previous social networks [4]. However, students experience different stressors and fluctuating levels of stress throughout this transition period [3].

A meta-analysis that included 64 studies from six continents published before March 28th, 2021, (Africa Region [$n = 5$]; Europe Region [$n = 7$]; North America [$n = 14$]; Australasia [$n = 1$]; Asia [$n = 36$]; Latin America [$n = 1$]) estimated a prevalence of 33.6 % (95 % CI: 29.3%–37.8 %) for depressive symptoms and 39.0 % (95 % CI: 34.6%–43.4 %) for anxiety symptoms among university students; however significant regional differences were found such that university students in African countries had the highest prevalence of depressive symptoms (40.1 %, 95 % CI: 12.3–67.9 %), whereas North American students had the highest prevalence of anxiety symptoms (48.3 %, 95 % CI: 37.4–59.2 %). Furthermore, in the studies conducted after the outbreak of coronavirus disease (COVID-19), the prevalence of depressive (35.9 %, 95 % CI: 20.2–51.7 %) and anxiety symptoms (40.7 %, 95 % CI: 39.5–42.0 %) was higher [5]. In addition to this meta-analysis, other studies show that the prevalence of depressive and anxiety symptoms among college students has worsened during the pandemic. A meta-analysis of 27 studies from 11 countries (China, France, USA, Jordan, South Korea, Japan, Spain, Bangladesh, Lebanese, Switzerland and Isreal) conducted between 2019 and 2020, showed a prevalence of depressive symptoms of 39 % (95 % CI: 27–51 %) and anxiety symptoms of 36 % (95 % CI: 26–46 %). Moreover, this study reported differences in the mental health of college students based on country and the date of data collection [6]. The prevalence of depressive (60 %, 95 % CI: 46–74 %) and anxiety symptoms (60 %, 95 % CI: 46–74 %) in non-Chinese college students was higher than that in Chinese college students (26 %, 95 % CI: 21–30 % and 20 %, 95 % CI: 14–26 %), and increased higher after March 1, 2020. A systematic review that included 16 studies concluded that university students reported feeling more anxious, depressed, fatigued and distressed after the start of the pandemic compared to pre-pandemic levels [7].

In addition to stressors common to all university students, such as creating new emotional ties, dealing with doubts about a chosen course of study, or meeting demands of more challenging coursework [8], health students (university students that are completing training in health disciplines; e.g., medical doctors, nurses, psychologists), may experience additional stress in relation to clinical internships. Previous work has demonstrated a high prevalence of depression and anxiety in nursing students [9] and medical students [5]. Studies comparing health students with students from other fields indicate a higher prevalence of anxious and depressive symptoms in health students [10] and higher psychological distress [11].

Taken together, evidence to date on the prevalence of symptoms of depression and anxiety among college students points to differences based on country, area of study and time of data collection, among other factors. Identification of subgroups of students with higher rates of mental health problems can help pinpoint where help may be needed most. Given the discrepancies found between countries and over time, this study aims to analyze the differences in three European countries (Portugal, Sweden and Germany) and to analyze which factors are associated with poorer mental health among university students. We chose a sample of health and social science students, as these are areas that have been directly linked to the pandemic, since they involve dealing with health and social care. During the pandemic, these students have had their clinical teaching interrupted and have had constraints on their academic training, which can generate stress and anxiety. Given the common stressors faced by these students, we report here findings from both student groups.

In this sense, the aim of this study was.

1. to compare the mental health of Portuguese, Swedish and German university students in the health (medicine, nursing, dental services, others) and social sciences following the COVID-19 pandemic
2. to analyze the factors associated with more depression and anxiety symptoms in each country.

2. Methods

2.1. Study design, setting and participants

This study used a descriptive, comparative and cross-sectional survey design, based on the STROBE guidelines, and took place in 11 universities (7 in Portugal, 1 in Sweden and 3 in Germany) from October to December 2022 among university students. Students who were registered at the universities in the autumn of 2022 were asked to participate in the study.

This study was registered by Open Science Framework (OSF): https://doi.org/10.17605/OSF.IO/WJ7TD.

The study was approved by the Ethics Committee in each country, in Portugal by Ethical Commite from Universidade de Évora, reference 22055, May 4th' 2022; in Sweden by the Swedish Ethical Review Authority November 2022, no 2022-04690-01 and in Germany by the local psychological ethics commission of the University and Medical Clinic Hamburg-Eppendorf (LPEK-0536).

2.2. Data collection

In the 11 universities, data collection began in October 2022 and ended in December 2022. Each country performed its own data collection. The initial survey was written in Portuguese and then translated into English by a professional translator. Then, each partner translated the informed consent and sociodemographic data into the country-specific language (Swedish and German) or already available translated versions of the scales for each langauge were used. In all universities, an online survey was used. In the universities in Portugal, a web link was sent by email to the students by the researchers at each institution, who in their work have access to the University's contact data. On October 10, the researchers presented the study in classrooms and the students who agreed to participate responded via mobile phones or tablets. In Sweden, a web link via email was sent to students by staff. In Sweden, two reminders were sent two weeks apart to all respondents as the researchers could not track who had already responded. In Germany, invitations for participation were sent via email (distribution lists), were presented during classroom lectures and were also distributed via a social media campaign. In all three countries the researchers did not handle any personal data of potential participants.

2.3. Online survey (measures)

Data were collected by an online survey including 42 background questions and three standard measures of mental health. At the beginning of the online survey, information about the study was provided and students were asked to provide consent. This was followed by questions on background characteristics such as age, sex, nationality, socio-demographic characteristics (residence), socio-economic situation, whether they have/had mental health problems, alcohol/drug consumption habits, etc. To measure mental health, the Mental Health Inventory-5 (MHI-5) [12] (Rumpf et al., 2001), the General Anxiety Disorder-7 (GAD-7) scale [13] and the Patient Health Questionnaire (PHQ-9) [14] were used. All demonstrated good psychometric properties. A more detailed description of the questionnaires follows below.

2.3.1. MHI-5

The MHI-5 [12] consists of five questions ("How much time, during the last month, have you … ": 1. been a very nervous person, 2. felt calm and peaceful, 3. felt downhearted and blue, 4. been a happy person and 5. felt so down in the dumps that nothing could cheer you up) are rated on a 5-point Likert scale (0 = none of the time to 4 = all the time). A higher value indicates better psychological well-being. The internal consistency of the MHI-5 in the present study varied between $\alpha = 0.87$, $\alpha = 0.81$ and $\alpha = 0.88$ for students in Portugal, Germany and Sweden, respectively.

2.3.2. GAD-7

The GAD-7 [13] consists of seven questions: "During the last 14 days, how often have you been bothered by the following problems? 1. Feeling nervous, anxious or very stressed, 2. Unable to stop worrying or control your worry, 3. Worried too much about different things, 4. Had difficulty relaxing, 5. Been so restless that you had difficulty sitting still, 6. Became easily irritated or irritable and 7. Felt afraid that something terrible would happen. Items are rated on a four-point Likert scale (0 = Not at all to 3 = Almost every day). The internal consistency of the GAD-7 in the present study varied between $\alpha = 0.91$, $\alpha = 0.87$ and $\alpha = 0.89$ for students in Portugal, Germany and Sweden, respectively.

2.3.3. PHQ-9

PHQ-9 assesses the severity of depression symptoms, which has previously been used in all three countries, Sweden [15], Portugal [16] and German [17]. The PHQ-9 [14] consists of two questions where Question 1 has nine statements: "In the last 2 weeks, how often have you been bothered by any of the following problems": 1) Little interest or pleasure in doing things, 2) Feeling down, depressed, or hopeless, 3) Trouble falling or staying asleep, or sleeping too much, 4) Feeling tired or having little energy, 5) Poor appetite or overeating, 6) Feeling bad about yourself — or that you are a failure or have let yourself or your family down; 7) Trouble concentrating on things, such as reading the newspaper or watching television; 8) Moving or speaking so slowly that other people could have noticed? Or the opposite — being so fidgety or restless that you have been moving around a lot more than usual; and 9) Thoughts that you would be better off dead or of hurting yourself in some way. The statements are answered from 0 = not at all to 3 = nearly every day. The internal consistency of the PHQ-9 in the present study varied between $\alpha = 0.89$, $\alpha = 0.85$ and $\alpha = 0.88$ for students in Portugal, Germany and Sweden, respectively.

2.4. Statistical analyses

To test for differences in the mean MHI-5 score by country, a one-way ANOVA with the Welch correction was used, due to the violation of the equal variances' assumption. To test for differences in the GAD-7 and PHQ-9 scores by country, the Kruskal-Wallis test was applied due to the violation of the normality assumption but without violation in the equal variances' assumption. The Dunn test with Bonferroni correction was used for post hoc comparisons.

Pearson correlation coefficient was used to measure the correlation between age and depressive and anxiety symptoms.

To identify factors associated with more depression and anxiety symptoms, simple and multiple linear regression models were adjusted to PHQ-9 scores and GAD-7 scores in each country. Linear regression assumptions were assessed: 1) linearity: checked by a scatter plot; 2) normality: the Shapiro-Wilk test, as well as tests for skewness and kurtosis and visualization of the QQ-plot of the residuals; 3) homoscedasticity: checked by fitting values vs. residuals plot and with the test Breusch-Pagan test. Multicollinearity was checked and variance inflation factor (*VIF*) found to be < 1.4. In order to verify the assumptions, the response variable was transformed to (PHQ-9 score + 1)^0.5 and (GAD-7 score + 1)^0.5. All significant variables in the simple phase were selected for the multiple linear regression model ($p < 0.05$ in the *F* test) variables. To understand what factors have the most weight in each country in depression and anxious symptoms no interactions were included in the multivariate model, and the relative contribution of each significant value to the R^2 was calculated. Significant variables in the multiple regression models were identified as being significantly associated with depression or anxiety.

The statistical analysis was performed using R Project, version 4.2.2 (R Core Team 2022). The level of significance used was 0.05.

3. Results

The sample was composed of 1200 students from Portugal ($M = 22.3 \pm 6.7$ years), 272 students from Sweden ($M = 32.1 \pm 8.6$); and 198 students from Germany ($M = 24.2 \pm 5.6$). All students were in the health or social sciences.

Table 1 shows sociodemographic and academic characteristics of the sample in each country. In each country, more than 80 % of participants were female. 13.4 % of students in Sweden reported low socioeconomic status compared to 6.3 % in Portugal and 7.1 % in Germany. The percentage of those living with their parents was higher in Portugal. The percentage of working students was higher in Germany and much lower in Portugal.

3.1. Mental health

Table 2 shows mental health data of participants. The prevalence of (at least mild) depression symptoms was 72.7 % in Germany, 62.9 % in Sweden, and 60.3 % in Portugal. The prevalence of anxiety symptoms was 78.6 % in Portugal, 73.7 % in Germany, and 66.9 % in Sweden. The percentage of students who indicated having a previous mental disorder diagnoses is highest in Sweden ($\chi^2_{(2)} =$

Table 1
Sociodemographic and academic characteristics of students in each country.

Variable	Categories	Portugal ($n = 1200$)		Sweden ($n = 272$)		Germany ($n = 198$)	
		n	%	*n*	%	*n*	%
Sex	Female	958	80.2	238	81.8	166	83.8
	Male	237	19.8	33	18.2	32	16.2
Emotional relationship	Single	561	46.9	55	20.2	79	39.9
	In a relationship, living together	143	12.0	173	63.6	44	22.2
	In a relationship, not living together	470	39.3	39	14.3	75	37.9
	Other	22	1.8	5	1.8	0	0.0
Nationality	Portuguese/Swedish/German	1122	94.0	251	92.3	181	91.4
	Other	71	6.0	21	7.7	17	8.6
Socioeconomic level (Students perceptions)	Low	75	6.3	36	13.4	14	7.1
	Medium	1029	86.2	219	81.4	149	75.3
	High	90	7.5	14	5.2	35	17.7
Relocated from the official residence	No	645	53.8	238	87.8	98	49.5
	Yes	555	46.2	33	12.2	100	50.5
If relocated, going home frequency	Every weekend	198	36.3	4	12.9	5	5.0
	2 to 3 times/month	106	19.4	6	19.4	13	13.0
	Once a month	73	13.4	11	35.5	35	35.0
	Only during school breaks/holidays	168	30.8	10	32.3	47	47.0
Living situation during semester	Parents	525	43.8	22	8.1	39	19.7
	Alone	110	9.2	59	21.8	56	28.3
	Boyfriend/girlfriend	101	8.4	99	36.5	37	18.7
	Friends	377	31.4	0	0.0	31	15.7
	Other family	159	13.2	87	32.1	9	4.5
	Other	71	5.9	4	1.7	24	12.1
Working student	Yes	225	18.8	156	58.0	137	69.2
	No	974	81.2	113	42.0	61	30.8
Study cycle	Bachelor's/Undergraduate	1076	90.0	201	74.2	99	50.0
	Master's Degree	75	6.3	26	9.6	47	23.7
	Ph.D.	21	1.8	10	3.7	5	2.5
	Others	24	2.0	24	12.6	47	23.7
Academic performance (Students perceptions)	Poor	59	4.9	13	4.8	6	3.0
	Fair	276	23.1	22	8.1	23	11.6
	Average	681	56.9	98	36.3	63	31.8
	Good	157	13.1	112	41.5	89	44.9
	Excellent	24	2.0	25	9.3	17	8.6

Table 2
Mental health data of students in each country.

Variable	Categories	Portugal		Sweden		Germany	
		n	%	*n*	%	*n*	%
Previous mental disorder diagnoses	No	938	79.5	147	54.0	131	66.2
	Yes	242	20.5	125	46.0	67	33.8
Mental disorder(s) diagnosed after the pandemic started	No	145	59.9	100	80.6	38	56.7
	Yes	97	40.1	24	19.4	29	43.3
Received psychiatric consultations or psychotherapy	No	947	79.3	151	55.7	3	4.5
	Yes	247	20.7	120	44.3	64	95.5
Take medication for anxiety, depression, insomnia, or other psychiatric problems	No	905	75.4	209	77.1	147	74.2
	Yes	295	24.6	62	22.9	51	25.8
Medications prescribed by the doctor	No	104	35.5	3	4.8	20	41.7
	Yes	189	64.5	60	95.2	28	58.3
Depressive symptoms (PHQ-9)	No (0–5)	476	39.7	101	37.1	54	27.3
	Mild (6–9)	297	24.8	56	20.6	54	27.3
	Moderate (10–14)	211	17.6	60	22.1	52	26.3
	Moderate-severe (15–19)	159	13.2	37	13.6	26	13.1
	Severe (20–27)	57	4.8	18	6.6	12	6.1
Anxiety symptoms (GAD-7)	No (0–4)	257	21.4	90	33.1	52	26.3
	Mild (5–9)	494	41.2	95	34.9	71	35.9
	Moderate (10–14)	283	23.6	55	20.2	52	26.3
	Severe (15–21)	166	13.8	32	11.8	23	11.6

80.435, $p < 0.001$). Of these, the percentage who indicated that at least one mental disorder was diagnosed after the pandemic started is higher in Portugal and Germany ($\chi^2_{(2)} = 18.173$, $p < 0.001$) (Table 2).

Around one quarter of participants in each country reported taking medication for anxiety, depression, insomnia or other psychiatric problems (Table 2). The type of medication most used by students was natural medication (e.g., valeriana) in Portugal (12.4 %) and Germany (13.6 %) and in Sweden it was antidepressants (17.3 %). In Portugal, 8 % of students reported taking antidepressants and/or benzodiazepines. In Germany, the second drug taken most frequently by students was antidepressants (12.1 %), followed by psychostimulants (3 %). In Sweden, following antidepressants, natural medications (2.6 %) were taken most frequently, followed by benzodiazepines (1.8 %). The percentage of students reporting taking antipsychotics in Germany, Portugal and Sweden were 2.5 %, 1.5 % and 1.1 %, respectively. In Portugal, none of the respondents took psychostimulants, and in Sweden, 1.8 % of the students surveyed reported currently taking them. Mood stabilizers were also mentioned by students in Sweden (1.5 %), Portugal (0.8 %) and Germany (0.5 %).

With regard to symptoms of anxiety and depression, mean scores were, on average, in the mild range (PHQ-9: Portugal = 8.28 ± 6.05; Sweden = 8.99 ± 6.39, Germany = 9.55 ± 5.45; GAD-7; Portugal = 8.62 ± 5.23; Sweden = 7.57 ± 5.28; Germany = 8.25 ± 4.93). MHI-5 scores were as follows: Portugal: 54.97 ± 19.06; Sweden: 57.5 ± 20.55; Germany: 56.21 ± 15.63. There were significant differences in PHQ-9 scores between countries ($\chi^2_{(2)} = 12.918$, $p = 0.002$) such that German students had significantly higher PHQ-9 scores than Portuguese students ($p = 0.002$). Significant differences in GAD-7 scores were also found between countries ($\chi^2_{(2)} = 10.155$, $p = 0.006$) such that Portuguese students had significantly higher GAD-7 scores than Swedish students ($p = 0.005$). There were no significant differences in the mean MHI-5 score between countries ($F_{(2,\ 421)} = 1.953$, $p = 0.143$; Fig. 1).

Regarding the diagnosis of mental disorders, the ones most identified by students were depression and anxiety in all three countries

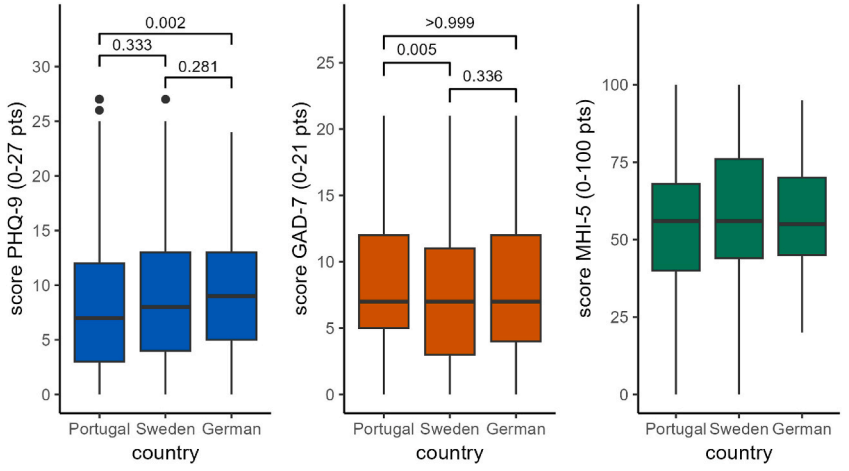

Fig. 1. Scales by country. *Note:* the values above the brackets indicate p-values for the group-wise comparisons).

(Fig. 2).

3.2. Factors associated with depressive symptoms

In Portugal, age tended to be negatively and linearly associated with PHQ-9 score; however, this correlation did not reach significance ($r = -0.065$, $p = 0.024$). In Sweden, there was a very weak negative linear correlation between age and the PHQ-9 score ($r = -0.312$, $p < 0.001$). In Germany there is no linear correlation between age and the PHQ-9 score ($r = -0.020$, $p = 0.779$).

Among Portuguese students, the simple regression model indicated that being a female student, having a previous diagnosis of a mental disorder, having poor academic performance, and consuming tobacco or cannabis was correlated to greater depression severity (PHQ-9 score). Furthermore, students who indicated that their mental health "strongly improved" during the COVID-19 pandemic had overall more severe depressive symptoms. In contrast, a higher socioeconomic level was associated with lower PHQ-9 scores (Table 3). In the final multiple regression model, socioeconomic status, academic performance, the effect of COVID-19 on mental health, having a previous diagnosis of mental disorder, and abstinence from alcohol and cannabis were signficiantly associated with PHQ-9 score (Table 3). Academic performance and the effect of COVID-19 on mental health explained the most variance in current mental health status (Table 4).

Among Swedish students, being female, having a lower socioeconomic level, living away from home, having worse academic performance, having a previous diagnosis of mental disorder, and consuming tobacco were found to be significantly associated with a higher PHQ-9 score. However, in the final adjusted multiple linear regression model, only the variables gender, socioeconomic status, living away from home, academic performance, having a previous diagnosis of mental disorder and drinking coffee significantly explained the variance in PHQ-9 scores (Table 3). Among these, academic performance made the largest contribution to explaining the variance in mental health (Table 4).

With regard to German students, being female, having a lower socioeconomic status, reporting a greater reduction of mental health status during the COVID-19 pandemic and having a previous diagnosis of a mental disorder were significantly associated with greater depressive symptoms. In contrast, better academic performance was associated with fewer depressive symptoms. In the final adjusted multiple linear regression model, alcohol consumption was also associated with a lower PHQ-9 score (Table 3). Among all variables in the model, the effect of COVID-19 on mental health accounted for the most variance in current mental health (Table 4).

The adjusted R^2 of the final multiple linear regression models ranged between 23% and 30 %, indicating that in the examined models, a notable amount of variance of PHQ-9 score remained unexplained (Table 4). Therefore, to improve the explanatory capacity of the models, it is necessary to include additional variables in the models.

3.3. Factors associated with anxiety symptoms

In Portugal ($r = -0.082$, $p = 0.005$) and Sweden ($r = -0.304$, $p < 0.001$), weak but significant negative linear correlations between age and the GAD-7 score were detected. In contrast, in Germany, no linear correlation between age and the GAD-7 score could be detected ($r = -0.001$, $p = 0.987$).

In Portugal, the simple regression model revealed that being afemale student, having lower levels of academic performance, having a previous diag nosis of mental disorder and reporting strongly improved mental health during the COVID-19 pandemic was correlated with greater anxiety symptoms (GAD-7 score). In the final multiple regression model, all variables were significantly associated with GAD-7 scores (Table 5). Among these, academic performance and the impact of COVID-19 on mental health accounted for the most variance in mental health (Table 6).

Among Swedish students, being female, having a lower socioeconomic level, living away from home, having lower poorer self-rated academic performance, having a previous mental health diagnosis, consuming tobacco and not consuming alcohol were found to be significantly associated with greater anxiety. However, in the final adjusted multiple linear regression model, gender, living away from official residence, academic performance, the effect of COVID-19 on mental health, having a previous mental health diagnosis and the consumption of coffee and alcohol accounted for the most variance in GAD-7 score (Table 5). Academic performance explained the most variability in students' mental health status (Table 6).

According to the simple linear regression analysis among German students, being female, not living away from home, reporting a

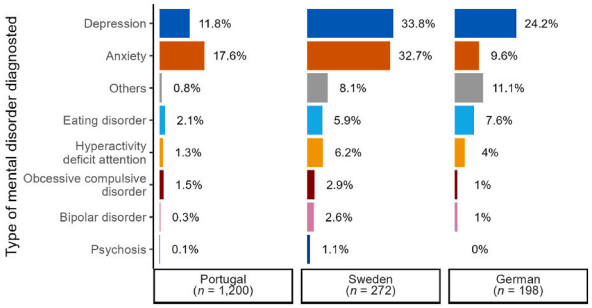

Fig. 2. Frequency of mental disorder by country.

Table 3
Fitted simple and multiple linear regression models showing factors independently associated with depressive symptoms ((PHQ-9 score +1)^0.5) among Portuguese, Swedish and German students (*b*: estimated coefficient, *p*: p-value).

Explanatory variables	Portugal				Sweden				Germany			
	Simple model		Multiple model		Simple model		Multiple model		Simple model		Multiple model	
	b	p	b	p	b	p	b	p	b	p	b	p
Sex (Ref: Female)												
Male	−0.251	**<0.001**			−0.448	**0.021**	−0.592	**0.001**	−0.524	**0.002**	−0.455	**0.002**
Socioeconomic level (Ref: Low)												
Medium	−0.331	**0.007**	−0.250	**0.021**	−0.671	**<0.001**	−0.502	**0.004**	−0.621	**0.009**	−0.572	**0.009**
High	−0.480	**0.003**	−0.270	0.059	−0.970	**0.003**	−0.525	0.085	−0.876	**0.001**	−0.792	**0.002**
Relocated from the official residence (Ref: No)												
Yes	−0.058	0.323			0.576	0.003	0.487	0.008	−0.238	0.053		
Academic performance (Ref: Poor)												
Fair	−0.478	**<0.001**	−0.291	**0.026**	−0.761	**0.028**	−0.493	0.141	−0.373	0.339	−0.219	0.536
Average	−0.996	**<0.001**	−0.699	**<0.001**	−0.730	**0.013**	−0.527	**0.066**	−0.663	0.069	−0.412	0.212
Good	−1.106	**<0.001**	−0.913	**<0.001**	−1.254	**<0.001**	−0.905	**0.002**	−0.852	**0.018**	−0.643	**0.049**
Excellent	−1.225	**<0.001**	−1.002	**<0.001**	−1.573	**<0.001**	−1.258	**<0.001**	−0.931	**0.022**	−0.834	**0.023**
COVID-19 pandemic mental health effect (students perception)(Ref.: Strongly improved[a])												
Improved	−0.590	**<0.001**	−0.285	**0.008**	−0.067	0.865						
No impact	−1.101	**<0.001**	−0.686	**<0.001**	−0.398	0.275			−0.216	0.355	−0.306	0.175
Deteriorated	−0.872	**<0.001**	−0.576	**<0.001**	−0.026	0.944			0.198	0.383	0.169	0.432
Strongly deteriorated					0.649	0.109			0.875	**0.003**	0.718	**0.011**
Previous mental disorder diagnoses (Ref: No)												
Yes	0.775	**<0.001**	0.597	**<0.001**	0.523	**<0.001**	0.422	**<0.001**	0.365	**0.005**		
Consumes coffee (Ref: No)												
Yes	0.090	0.220			0.219	0.288	0.377	0.051	0.057	0.825		
Consumes tabaco (Ref: No)												
Yes	0.226	**<0.001**			0.490	**0.006**			0.116	0.362		
Consumes alcohol (Ref: No)												
Yes	−0.129	0.135	−0.164	**0.036**	−0.241	0.108			−0.317	0.073	−0.333	**0.038**
Consumes cannabis (Ref: No)												
Yes	0.338	**<0.001**	0.287	**0.002**	0.095	0.791			0.016	0.905		
Consumes other substances (Ref: No)												
Yes	0.130	0.614			0.786	0.137			0.273	0.182		

[a] German: the reference category was improved.

Table 4
Relative contributions (R^2 contribution (%)) of determinants of PHQ-9 score identified in the final multiple regression model by country (n.s.: variables that were not significant in the model).

Explanatory variables	Portugal ($n = 1152$)	Sweden ($n = 268$)	German ($n = 198$)
Sex	n.s.	11.2	17.9
Socioeconomic level	3.5	18.5	18.7
Living away from home	n.s.	4.6	n.s.
Academic performance	36.7	31.6	18.8
COVID-19 pandemic mental health effect	33.5	17.1	38.5
Previous mental disorder diagnoses	22.6	11.1	n.s.
Consumes coffee	n.s.	5.8	n.s.
Consumes alcohol	0.9	n.s.	6.1
Consumes cannabis	2.8	n.s.	n.s.
R^2 (%)	23.4	29.2	27.9
Adjusted R^2 (%)	22.6	25.2	23.6

strong deterioration of mental health status during the COVID-19 pandemic and having a previous mental disorder diagnosis were significantly associated with more anxiety. In contrast, higher socioeconomic level and better academic performance were associated with a lower GAD-7 scores. In the final adjusted multiple linear regression model, only the variables gender, socioeconomic status and the effect of COVID-19 on mental health explained the variation in GAD-7 score (Table 5). The impact of the COVID-19 pandemic on mental health accounted for the largest amount of variability in students' mental health status(Table 6).

The adjusted R^2 of the final multiple linear regression models ranged between 16% and 31 %, indicating that in the models, a large amount of variability in GAD-7 scores remain unexplained (Table 6). Therefore, to improve the explanatory capacity of the models, it is necessary to include additional variables.

4. Discussion

Taken together, there were no significant differences between the countries in terms of MHI-5 scores.

In relation to mental disorders diagnostic, Swedish students most frequently (46 %) reported having a previous/current mental disorder, followed by German (33.8 %) and Portuguese (20.5 %) students. Among these individuals, more German (43.3 %) and Portuguese (40.1 %) students reported having been diagnosed during the pandemic, while only 19.4 % of the Swedish students reported receiving a mental health diagnosis during the pandemic. This points to the possibility that students in Sweden were less affected by the COVID-19 pandemic than those in Germany and Portugal. We further discuss this possibility below.

4.1. Depressive symptoms in university students

In line with knowledge regarding the prevalence of mental health disorders, the most commonly reported mental health disorders in Portugal, Sweden and Germany were depression (11.8 %; 33.8 %; 24.2 %) and anxiety (17.6 %; 32.7 %; 9.6 %), respectively. In contrast to our findings, the COVID-19 International Student Well-being Study, carried out in 26 countries during the first wave of the pandemic (April–July 2020) using the Center for Epidemiologic Studies - Depression Scale (CES-D 8), reported relatively more symptoms of depression in Portugal ($N = 851$) with a mean value of 10.29, followed by Germany ($N = 4778$) with a mean value of 9.19; and Sweden ($N = 1070$) with a mean value of 8.41 [18]. These discrepancies may be due to differeinces in the timeframe of the data collection as well as the instruments used. A study of Swedish students with pre- (2019) and post-pandemic (2020) data found that levels of anxiety symptoms remained stable during the first three months of the COVID-19 pandemic compared to pre-pandemic levels. Depressive symptoms increased only slightly. In the following three months, overall level of depressive symptoms decreased, at which point there was less spread of COVID-19 [19]. In Germany, one study on university students showed that depressive symptoms worsened while the levels of anxiety symptoms were maintained from MONTH 2019 until June 2020 [20]. In Portugal, university students showed a significant worsening in both depressive and anxiety symptoms from 2019 to 2020 [22]. For instance, a previous meta-analysis showed that the prevalence of depressive and anxiety symptoms increased during the pandemic in university students [5] and a systematic review concluded that university students reported feeling more anxious, depressed, tired and distressed after the start of the pandemic [7].

Our study differs from findings of the COVID-19 International Student Well-being Study. German students (45.5 %) were found to have the most moderate to severe symptoms of depression, followed by Swedish (42.3 %) and Portuguese students (35.6 %). Portuguese students had significantly fewer depressive symptoms than German students ($p < 0.005$). A study carried out in Germany with university students in 2020 found rates of depressive symptoms (mean 8.49 (5.31) PHQ-9) [20] to be lower compared to our study (mean 9.55 $\pm$ 5.45) [20]. Another study of German university students (data collection October/November 2021) obtained a prevalence of 28.9 % depressive symptoms [23]. A study of the Swedish population (June 2020–June 2021) using the PHQ-9 reported a prevalence of 32.2 % of depressive symptoms in young people between the ages of 18 and 29 [24].

These results lead us to believe that university students in Portugal had more depressive symptoms during the pandemic period. However, according to our results (data collection 2022), when activities returned to normal, depressive symptoms among German and Swedish university students remained consistent or increased whereas among Portuguese students they appear to have decreased

Table 5
Fitted simple and multiple linear regression models showing factors independently associated with anxious symptoms ((GAD-7 score +1)^0.5) among Portuguese, Swedish and German students (*b*: estimated coefficient, *p*: *p*-value).

Explanatory variables	Portugal				Sweden				Germany			
	Simple model		Multiple model		Simple model		Multiple model		Simple model		Multiple model	
	b	p	b	p	b	p	b	p	b	p	b	p
Sex (Ref: Female)												
Male	−0.373	**<0.001**	−0.273	**<0.001**	−0.449	**0.010**	−0.570	**<0.001**	−0.515	**0.001**	−0.438	**0.004**
Socioeconomic level (Ref: Low)												
Medium	−0.120	0.259			−0.455	**<0.001**	−0.256	0.096	−0.387	0.096	−0.315	0.154
High	−0.210	0.129			−0.637	**0.030**	−0.289	0.287	−0.672	**0.011**	−0.647	**0.011**
Relocated from the official residence (Ref: No)												
Yes	−0.048	0.346			0.494	**0.005**	0.339	**0.037**	−0.285	**0.017**		
Academic performance (Ref: Poor)												
Fair	−0.305	**0.015**	−0.198	0.096	−0.268	0.402	−0.061	0.837	−0.574	0.136		
Average	−0.36	**<0.001**	−0.364	**0.001**	−0.480	0.076	−0.364	0.152	−0.493	0.169		
Good	−0.679	**<0.001**	−0.572	**<0.001**	−0.817	**0.002**	−0.565	**0.026**	−0.705	**0.047**		
Excellent	−0.747	**<0.001**	−0.527	**0.010**	−1.099	**<0.001**	−0.815	**0.006**	−0.676	0.090		
COVID-19 pandemic mental health effect (Ref.: Strongly improved[a])												
Improved	−0.439	**<0.001**	−0.270	**0.005**	0.028	0.936	0.398	0.244				
No impact	−0.859	**<0.001**	−0.584	**<0.001**	−0.396	0.225	**0.043**	0.893	−0.102	0.654	−0.170	0.451
Deteriorated	−0.660	**<0.001**	−0.430	**0.002**	−0.011	0.974	0.304	0.355	0.218	0.331	0.149	0.493
Strongly deteriorated					0.597	0.099	0.750	**0.033**	0.805	**0.005**	0.663	**0.019**
Previous mental disorder diagnoses (Ref: No)												
Yes	0.586	**<0.001**	0.427	**<0.001**	0.460	**<0.001**	0.337	**0.001**	0.353	**0.005**		
Consumes coffee (Ref: No)												
Yes	0.081	0.202			0.277	0.137	0.524	**0.003**	0.062	0.805		
Consumes tabaco (Ref: No)												
Yes	0.085	0.128			0.410	**0.010**			−0.064	0.606		
Consumes alcohol (Ref: No)												
Yes	−0.018	0.814			−0.460	**<0.001**	−0.394	**0.001**	−0.142	0.409		
Consumes cannabis (Ref: No)												
Yes	0.106	0.234			0.234	0.466			−0.052	0.698		
Consumes other substances (Ref: No)												
Yes	−0.010	0.963			0.401	0.401			−0.021	0.917		

[a] German: the reference category was improved.

Table 6
Relative contributions (R^2 contribution (%)) of determinants of GAD-7 score identified in the final multiple regression model by country.

Explanatory variables	Portugal ($n = 1158$)	Sweden ($n = 264$)	German ($n = 198$)
Sex	12.5	12.7	22.9
Socioeconomic level		10.0	21.6
Relocated from the official residence		3.8	
Academic performance	21.5	22.0	
COVID-19 pandemic mental health effect	44.8	24.0	55.5
Previous mental disorder diagnoses	21.1	9.2	
Consumes coffee		8.5	
Consumes alcohol		9.8	
R^2 (%)	16.2	30.8	16.2
R^2 (%)	16.2	30.8	16.2
Adjusted R^2 (%)	15.5	26.6	13.5

[18]. This data should be; however, interpreted with caution since our study only evaluated students from the health and social sectors. Nonetheless, a Portuguese study that collected data at the same time as the current one reveals that depressive symptoms are lower in health students compared to other fields [25].

As previously mentioned, the timing of our data collection likely also impacted results. The data for our study was collected data at the end of 2022, when all restrictions had been lifted and classes had returned to normal. The COVID-19 International Student Well-being Study [18] collected data from April to July 2020 when the countries had pandemic restrictions. Of these three countries, Portugal was the one with the strictest containment measures. This study concluded that in countries with more restrictions and containment measures, university students showed more depressive symptoms. School and workplace closures closures and stay-at-home restrictions were the most prominent measures associated with students' depressive symptoms [18]. This may be one of the reasons why rates of depressive and anxiety smptoms were higher in Portugal while pandemic restrictions were in place whereas in our study carried out at the end of 2022 when classes returned to being face-to-face, depressive and anxiety symptoms were relatively lower.

4.2. Anxiety in university students

Regarding anxiety, in our study, we found that the frequency of moderate to severe symptoms of anxiety was highest among German students (37.6 %) followed by Portuguese (34.7 %) and Swedish students (32 %). A study of German university students using the short versions of the same scale used in this study (GAD-2), which collected data a year before our study (October/November 2021) reported a lower prevalence (31.5 %) of anxiety symptoms [23]. Similar results were found in Sweden. A study using the GAD-7 showed a 24 % prevalence of anxiety symptoms among 18–29 year olds from June 2020 to June 2021 [24]. A Portuguese study that used the same scale (GAD-7) with students from all areas at the same time as this study showed a higher prevalence (37.1 %) of moderate to severe anxiety symptoms [25].

Based on a meta-analysis which concluded that the prevalence of symptoms of depression (39.4 %) and anxiety (47.1 %) was much higher among medical students [5], we conducted sensitivty analyses based on specific area of study. These results lead us to question whether there are differences between each of the specific areas (medical, nurses, other health areas) within health students. Comparing the results of the three countries, we find that Swedish students have significantly fewer anxious symptoms than Portuguese students. A study of Swedish students ($N = 1835$) with data collected at three different times throughout the pandemic (September 2020, December 2020–January 2021 and March–April 2021) found that average levels of anxiety symptoms changed very little. The same authors conclude that the mental health of Swedish university students has remained relatively stable during the COVID-19 pandemic [26]. In Portugal, anxiety symptoms seem to have worsened in university students over the course of the pandemic. A study using the same scale before the pandemic ($N = 1031$) reported a prevalence of 23.9 % of moderate to severe anxiety symptoms [27], while a study carried out at the end of 2022 using the same scale reported a prevalence of 37.1 % [25]. In addition, a systematic review of the literature reported that anxiety symptoms increased from 19 % to 37 % [6]. Another systematic review of the literature with medical students concluded that the COVID-19 pandemic had a negative impact on their mental health, increasing symptoms of depression and anxiety. The authors concluded that this increase could be associated with the transition to e-learning, reduced social support, social isolation, disturbances in clinical internship and decreased self-efficacy to cope with the context experienced [28]. In short, it seems that Swedish students showed relative stability in anxiety levels throughout the pandemic, which may indicate the efficacy of the mental health management strategies implemented in Sweden during this period. Portuguese students in particular appear to have been more affected compared to their German and Swedish peers. These differences may be influenced by contextual factors, such as the degree of pandemic restrictions and the support offered during the transition to e-learning. In view of this data, it seems to us that much remains to be explained, and that more comparative studies between countries are important in order to understand the cause of the differences between them, which can range from cultural to socio-economic.

4.3. Factors associated with more depressive and anxious symptoms

Being a female student, having a previous diagnosis of a mental disorder, and poor academic performance were associated with

more severe depression and anxiety symptoms in three countries. Low socioeconomic level was associated with more severe depression symptoms in all three countries and a higher severity of anxiety in Germany and Sweden. Living away from home was associated with more depression and anxiety symptoms in Sweden, whereas in Germany, not living away from home was associated with more anxiety symptoms.

The average age of students differed among countries such that, Swedish students had a higher average age (32.1 ± 8.6) than Portugal (22.3 ± 6.7) and Germany (24.2 ± 5.6). In Portugal and Sweden, younger students showed significantly more depression and anxiety symptoms. In Germany, there was no association between age and these symptoms. A Swedish study of the general population shows congruent results, demonstrating a tendency for the level of depression and anxiety symptoms to decrease with increasing age [29]. However, a longitudinal study of adults in seven European countries with three data collection times (November 2020, $n = 7115$; January 2021, $n = 7068$; and April 2021, $n = 7204$) concluded that age was negatively correlated with severity of depression and anxiety symptoms. Other studies with medical students ($n = 2057$) reported that older students (≥20 years) had higher levels of anxiety and depression symptoms [30]. Taken together, the data remains broadly contradictory with regard to the overall association between age and mental health symptoms and probably depends on many factors, including the course of study, the ability to integrate into the university environment and financial support. Moderators of the associations between age and mental health should therefore be identified.

Women had higher values of depression and anxiety in all three countries, which is consistent with previous work globally [5,20,21,23,31–33]. Although this is a non-modifiable factor, there may be other factors associated with gender that contribute to these results, and more research is needed in this area, as Kuehner suggests [34].

Having a previous diagnosis of a mental disorder was associated with increased severity of anxiety and depression. These results are corroborated by a longitudinal study (27 March to June 15, 2020), with a sample of 6551 adults from Germany, which concluded that depression and anxiety symptoms during the COVID-19 pandemic were significantly higher in individuals with mental disorders [35]. Additionally, Karing (2021) reported that worry about COVID-19 pandemic-related factors, such as pandemic-related financial or academic worries were associated with higher rates of anxiety [36].

In relation to academic performance, in all three countries, students who perceived having a poor academic performance had more depression and anxiety symptoms. A study using the MHI-5 showed similar results: perception of academic performance was positively associated with mental health [37]. A meta-analysis showed similar results only for anxiety; however this association was not detected for depression [5]. However, in a study of medical students, poor academic performance was an independent predictor of depression [38]. Importantly, in our study, academic performance was based on students' self-reports versus grades. As such, perceptions of poorer academic success may be due to low self-esteem, an in turn more depression and anxiety symptoms. On the other hand, academic performance may be low due to the prior presence of anxiety and depression symptoms. The cross-sectional nature of this study prohibits identification of cause and effect relationships and further longitudinal studies are needed to establish causal relationships.

Further, low socio-economic status was significantly associated with more severe depression symptoms in Portugal, Sweden and German. This has been consistently reported in various studies [5,7,39] and is also one of the health determinants reported by the WHO [40]. In this sense, it is urgent to take political measures to improve people's living conditions, acting in accordance with the objectives of sustainable development.

The association of living away from home with mental health was variable across countries. In Sweden, it was associated with more depression and anxiety symptoms, but in Germany not living away from home was associated with more anxiety symptoms. In line with results from Sweden, one study demonstrated that living away from home was associated with greater use of mental health services [41]. Another study reveals that living away from home, without family or friends, may be associated with more depression or anxiety symptoms [42,43]. In this sense, the data from Sweden is not surprising, since students who are displaced, far from their families, have to adapt to a new context, often going to study in an environment where they don't know anyone. In addition, relationships are extremely important for mental health, so being away from family and friends may influence this result in light of social support. However, given that findings varied across countries, this points to the specific of cultur/country-specific influences, which should be more specifically examined.

With respect to substance use, in Portugal and Sweden, smoking was significantly associated with more severe symptoms of depression and in Sweden only, smoking was significantly associated with more severe anxiety symptoms. These results are corroborated by a meta-analysis carried out with five studies [5]. Another recent study with medical students found an association between substance use (including tobacco and/or alcohol) and depression [38]. In Portugal, cannabis was associated with more depressive symptoms. A meta-analysis showed that cannabis use disorder was strongly associated with major depression and generalized anxiety disorder [44]. The act of smoking tobacco or cannabis is often used as a maladaptive coping strategy to reduce anxiety, so it makes sense that students who smoke have more severe depressive and anxiety symptoms.

The results for alcohol consumption are surprising, given that Swedish students who don't consume alcohol show more anxiety symptoms and German students who don't consume alcohol show more depressive symptoms. Previous studies of university students reveal that alcohol consumption is associated with depressive and/or anxiety symptoms [45–47]. Given that in our study we only asked about frequency of consumption (from never to daily) and did not assess the quantity, this does not mean that the amount of alcohol consumed is harmful. These results can be explained by the stage of academic life the students are in, when alcohol is consumed at student parties. Thus, those who consume alcohol may be those who socialize the most and not exactly those who consume alcohol as a result of anxiety or depression.

This study has some limitations, such as the fact that it is cross-sectional and does not allow for making conclusions about causality, as well as the fact that sample sizes differ between countries. Another limitation is pandemic impacted countries differently, which may have affected the results, such as university education and financial support. In respect to sex, in Portugal, Sweden and Germany, in

some areas of health, such as nursing, most students are female and it is a limitation of this study. Strenghs include the large sample sizes as well the cross-country comparision. Also, the timing of data collection was the same in all countries, allowing to compare temporal conditions.

5. Conclusion

Factors such as being female and young, having a previous diagnosis of a mental disorder, having poor perceived academic performance low socioeconomic level and living away from home were associated with more depression and anxiety symptoms in university students. Some of these factors are modifiable, so it is urgent to change policies to respond to the health determinants recommended by the WHO. For Portugal, where students face significant challenges related to anxiety and depression, especially due to lower socioeconomic conditions, it is crucial that policies focus on improving financial and psychological support for university students. Specific examples include increasing scholarships and expanding psychological counselling services at universities, as well as creating mentoring programmes to help with adaptation to the academic environment. In Sweden, where there is a strong tradition of social policies and student support, the recommendation would be to intensify the integration of new students through mental health programmes focused on prevention. Considering the high prevalence of depressive symptoms observed, it would be beneficial to develop workshops on resilience and emotional well-being for all students at the beginning of the academic year, promoting a culture of mutual help and peer support. For Germany, where a high level of depressive symptoms was observed, it is suggested to create policies that include closer monitoring of students living away from home and those with a history of mental disorders. Another suggestion would be to implement specific psychological support programmes at universities, including providing support groups and strengthening partnerships with local mental health services. Ultimately, we hope that these strategies will contribute to improving the mental health of university students in Europe, in line with the Sustainable Development Goals and WHO guidelines.

CRediT authorship contribution statement

Lara Guedes Pinho Writing – original draft, Resources, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. **Maria Engström:** Writing – review & editing, Supervision, Conceptualization. **Brooke C. Schneider:** Writing – review & editing, Methodology, Investigation. **Cesar Fonseca:** Writing – review & editing, Funding acquisition. **Magnus Lindberg:** Writing – review & editing. **Johanna Schröder:** Writing – review & editing, Methodology, Investigation. **Anabela Afonso:** Formal analysis, Data curation. **Lena Jelinek:** Writing – review & editing. **Johanna Börsting:** Writing – review & editing, Investigation. **Gonçalo Jacinto:** Formal analysis, Data curation. **Annika Nilsson:** Writing – review & editing, Resources, Methodology, Investigation.

Ethical statement

This study was reviewed and approved by the Institutional Review Board of the three countries. Portugal: approved by Ethics Committee of the University of Évora, with the approval number 22067; German: approved by Local Ethics Committee of Psychologists at the University Medical Center Hamburg, with the approval number LPEK-0523; Sweden: approved by The Swedish Ethical Review Authority, with the approval number 2022-04690-01.

All participants provided informed consent to participate in the study and for the publication of the data.

Data availability statement

Due to data protection restrictions in the country and ethics commission rules, as the data is sensitive data, it cannot be made freely available. Partial data that does not jeopardize data protection can be requested from the study coordinator at lmgp@uevora.pt.

Funding statement

This work is funded by national funds through the Foundation for Science and Technology, under the project UIDP/04923/2020.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:Lara Guedes de Pinho reports was provided by University of Évora. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

The authors would like to thank all the researchers who helped collect the data, all the professors who allowed the data to be collected in some classrooms and, above all, all the students who took part in the study by answering the questionnaire.

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