Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Depressive symptoms in higher education students during the first wave of the COVID-19 pandemic. An examination of the association with various social risk factors across multiple high- and middle-income countries.

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Depressive symptoms in higher education students during the first wave of the COVID-19 pandemic. An examination of the association with various social risk factors across multiple high- and middle-income countries.

ABSTRACT

Higher-education students face substantial risks for developing depressive symptoms during the COVID-19 pandemic or experiencing exacerbated pre-existing depressive symptoms. This study uses data from the COVID-19 International Student Well-Being Study, which collected data through a non-representative convenience sample in 125 higher-education institutions (HEI) across 26 high- and middle-income countries (N: 20,103) during the first wave of the COVID-19 pandemic. It describes the prevalence of depressive symptoms in higher-education students. We find substantial cross-national variation in depressive symptoms, with lowest mean levels established in the Nordic countries and France, while highest mean levels of depressive symptoms were found in Turkey, South Africa, Spain and the USA. Elevated risk for depressive symptoms was found in female students, students with fewer social support resources and in a more disadvantaged socioeconomic position, and students with a migrant background. COVID-19 related stressors, such as reduced social contact, increased financial insecurity, and academic stress explained a relatively larger proportion of the variance in depressive symptoms compared to non-COVID-19 related stressors. This finding shows that not the pandemic itself, but rather the secondary effects of the pandemic relate to students' mental health. Our results enable HEIs to be better equipped to target groups that are particularly at risk during a pandemic.

Key terms: depressive symptoms, higher education students, COVID-19

1. Introduction

Students in higher education face substantial risks for developing mental health problems (Auerbach et al., 2016; Storrie et al., 2010). When entering higher education, students are confronted with a substantial change in the nature of the school experience: compared to secondary school, higher education institution (HEI) 's involvement becomes more discretionary, the time spent receiving direct instruction is relatively small, and more learning is to be done through independent self-study and assigned work. As a result, many students experience elevated levels of academic stress (Chambel & Curral, 2005), which may continue throughout the years in higher education, given the highly challenging curricula, an intensive and time-consuming workload, and high intellectual demands (Wege et al., 2017).

Students additionally experience new demands outside of the classroom, including significant changes in the interactions with important others. In many countries, students move out of their parental home (Buhl & Lanz, 2007), and as a result, may experience less parental involvement and support (Fisher, 1994). In the Mediterranean and other countries, living in the parental home remains the most common form of student housing (Hauschildt et al., 2015), but parental involvement changes considerably nonetheless (Sestito & Sica, 2014). Regardless of the context, peers and friends continue to play a prominent role, and these relationships tend to be characterized by greater emotional depth and complexity (Arnett, 2014). However, many students entering higher education find it difficult to adapt and make new friends (Buote et al., 2007). As a result, they can become isolated and may suffer in silence or drop out without seeking help. Mature students, in particular, may find themselves isolated within the institutional environment, even if they remain in their own family home and commute to the university (Mallman & Lee, 2017). This problem is not restricted to first-year students, as relationship stressors (i.e., family, romantic, peer, and faculty relationships) were the most commonly reported source of stress among all students (Hunt & Eisenberg, 2010).

Both higher education itself and the more independent living situation account for substantial financial costs – causing many students to seek an income from a paid job. A comparison between

OECD countries showed that about 40% of students combine their studies with employment, from about 15% in Italy to over 60% in the Netherlands (Quintini, 2015). The financial strain associated with student life constitutes a source of stress for an increasing proportion of the student population (Dundes & Marx, 2006). A substantial group of students faces financial pressures (Cooke et al., 2004), which can have a significant long-term impact on their mental health (Richardson et al., 2017). While most countries have financial aids systems or government-sponsored student loan schemes, there is considerable variation in the size of the repayment and recovery ratios across schemes (Shen & Ziderman, 2009). In addition, research shows that the use of student loans is associated with lower psychological functioning (Walsemann et al., 2015).

Given these social stressors, a large number of empirical studies indeed point to elevated levels of mental health problems in the student population prior to the COVID-19 pandemic (Stallman, 2010; Storrie et al., 2010), which may reflect both newly developed mental health problems as well as exacerbated pre-existing problems (Cleary et al., 2011). Depression is one of the most common health problems in higher-education students (Auerbach et al., 2016), affecting about one-third of higher-education students (Ibrahim et al., 2013a), with some evidence of a steady rise in the number of depressed students during the previous decade (Mojtabai et al., 2016). Specific subgroups are considered more at risk for depression, consistent with studies in the general population (Stathopoulou et al., 2018; Van De Velde, 2013). These include students from a more disadvantaged socioeconomic background (Ibrahim et al., 2013b), female students (Hunt & Eisenberg, 2010), students with relationship stressors (Blanco et al., 2008), and lower social support (Hefner & Eisenberg, 2009). The academic environment has been found to be particularly stressful for ethnic minority students (Hayes et al., 2011; OECD, 2018).

Students' vulnerability to mental health problems may have additionally increased during the COVID-19 pandemic as students were confronted with governmental lockdown measures, in addition to measures implemented by their HEI. Most countries initially implemented COVID-19 protective

measures to reduce the spread of the virus. However, they differed in timing and calibration of specific responses and the intensity with which the various policies were deployed –from compulsory quarantines to voluntary lockdowns and social distancing measures (Capano et al., 2020). These measures led to a complete reorganization of higher education, including converting face-to-face lectures to online classes, the partial or total cancellation of internships, laboratory attachments, and fieldwork, and the adaptation of assessment methods to COVID-19 protective measures (Aristovnik et al., 2020; UNESCO, 2020). This may have created the risk of students feeling isolated in the learning process (Husky et al., 2020). First-year students (Aslan & Pekince, 2020), students within study fields that require onsite training (Abdulghani et al., 2020), and students with lower ICT accessibility and familiarity (Aristovnik et al., 2020) may have been particularly hit by this shift in teaching-method. It may have resulted in a larger workload for many students, a reduction in academic support from peers and lecturers, and increased difficulties to focus during lectures, but substantial cross-national variation in these risk factors was found as well (Aristovnik et al., 2020).

The COVID-19 outbreak also had a substantial impact on many students' lives outside the classroom. Many students moved back home during the outbreak of the COVID-19 pandemic (Fry et al., 2020). This may have constituted a source of conflict, with breached emotional boundaries, physical privacy, and parental intrusiveness (Aquilino, 2006). Simultaneously, physical proximity and face-to-face encounters with friends and peers were minimized due to the social distancing measures. Recent evidence indeed points to the devastating effect of these measures on young adults' mental health (Loades et al., 2020). In addition, the stagnation of the economy may have resulted in additional financial worries for students who rely on income through work (Husky et al., 2020).

The currently available research on mental health in the general population confirms a negative psychological impact of the COVID-19 outbreak (Dong & Bouey, 2020; Etheridge & Spantig, 2020; Kang et al., 2020; Li et al., 2020; Singhal & Vijayaraghavan, 2020; UNESCO, 2020; Wang et al., 2020a), and indicates that this impact is relatively long-lasting (Wang et al., 2020b). Research that

focuses on mental health in higher-education students points in the same direction (Hongbo & Waqas, 2020; Liu et al., 2020b; Savarese et al., 2020; Son et al., 2020; Wang et al., 2020a). Most of these studies are, however, single-country studies with sometimes relatively low sample sizes. As a result, it remains unclear whether these findings can be generalized to different countries, given that the pandemic did not hit equally hard in every country and given the wide variety in which students were confronted with the secondary effects of the pandemic across various countries.

To the best of our knowledge, only one study to date described the results of a comprehensive multicounty study on the impact of the COVID-19 pandemic on levels of satisfaction in higher-education students. It reported that the COVID-19 pandemic has had a significant impact on students' social and academic life and that this impact varied substantially across countries (Aristovnik et al., 2020). Our study builds upon this study's findings by examining how these multiple changes in higher-education students' lives due to the COVID-19 pandemic relate to levels of depressive symptoms. It aims to (1) describe mean levels of depressive symptoms in students in the participating countries, (2) examine its relationship with well-established social stressors of depressive symptoms in students in these countries, (3) examine how COVID-19 specific stressors may contribute to this relationship, and finally (4) examine whether and how the associations between these social stressors and depressive symptoms in higher-education students varies across the participating countries. As a result, our study is the first to present levels of depressive symptoms in higher-education students in various national contexts during the COVID-19 pandemic.

2. Methods

2.1 Data

Data stem from the COVID-19 International Student Well-being Study (C19-ISWS), which collected information on student well-being and social correlates during the first wave of the COVID-19 pandemic in 125 HEIs in 26 countries through a non-representative stratified convenience sampling design. Data collection took place between April 27, 2020, and July 7, 2020, with two-thirds of HEIs

collecting the data within the first month of the initial launch. Within each HEI, the survey was active for two weeks, but a selection of HEIs prolonged this period to a maximum of four weeks in total. Respondents were recruited through direct emailing and were asked to fill out an online survey. Participants were eligible if they were enrolled in a higher education program, aged 17 or above, and provided informed consent. Ethical approval was obtained individually in all participating HEIs, and the multicountry research design was approved by the Ethics Committee for the Social Sciences and Humanities of the University of Antwerp, Belgium. More details about the study procedures can be found in the study protocol (Van de Velde et al., 2020).

The full information sample consisted of 99,689 higher-education students. For this study, a subsample of the data was used to cover each participating country during a period with relatively stable policy measures (see Appendix A and B). Next, Ph.D. students were excluded from the sample because in many of the sampled HEIs, they hold a paid employee status, thereby making them less comparable to other higher-education students. Finally, a random selection of 1,000 cases was drawn in countries with a larger size sample in order to correct for an overrepresentation of these countries in the total sample. This results in an analytical sample consisting of 20,103 respondents (73.9% is female, 78.3% is below the age of 26). Descriptive statistics are presented in Appendix C.

2.2 Variables

Symptoms of depression – An eight-item version of the Center for Epidemiologic Studies–Depression Scale (CES-D-8) scale was used to measure the frequency and severity of depressive symptoms (Radloff, 1977). Respondents were asked to indicate how often in the week previous to the survey they felt or behaved in a certain way (felt depressed, felt that everything was an effort, slept poorly, felt lonely, felt sad, could not get going, enjoyed life, or felt happy – last two items are reverse-coded). Response categories forming a 4-point Likert scale ranged from *none* or *almost none of the time* (0) to *all* or *almost all of the time* (3). Scale scores for the CES-D-8 were assessed using a non-weighted summed rating and ranged from 0 to 24, with higher scores indicating a higher frequency

and severity of depressive symptoms. The reliability and the validity of the inventory were confirmed across a wide selection of European countries (Van de Velde et al., 2010b). In the C19 ISWS sample, the country-specific Cronbach's alphas ranged between 0.85 and 0.90 (Van de Velde et al., 2020).

Sociodemographic factors – The following variables were taken into account: gender (men, women), age (between 17-25 years old [ref.] or aged 26 or older), relationship status (single [ref.], in a steady relationship, in a complicated relationship), and migrant background (no migrant background [ref.], first-generation migrant background, and second-generation migrant background). Age was included as a dichotomous variable to avoid a strong overlap with study program (see below).

Socioeconomic and social support factors – Because students have not completed their educational training, and their current income or job status are no adequate measures of their socioeconomic status, the highest level of education – (1) less than secondary, (2) secondary, and (3) higher education (ref.) – attained by either parent was used as a proxy of their socioeconomic status (Marmot, 2005). For students' *subjective financial status before the COVID-19 outbreak*, respondents indicated to what degree they agreed with the statement: *'I had sufficient financial resources to cover my monthly costs*'. Students who (strongly) disagreed with this statement were group together (score 1). In order to assess the respondent's social and economic capital (Abel, 2020), they were asked from how many persons within their network (partner, parents, siblings, grandparents, friends, colleagues and/or acquaintances) they could easily borrow an equivalent of 500 euros within two days (adjusted to the local currency). The variable is recoded into four categories: (1) zero persons, (2) one to two persons, (3) three to four persons, and (4) five or more persons (ref.). Finally, the degree of social support was assessed through information on the presence of a confidant (*Do you have anyone with whom you can discuss any intimate and personal matters?)*, with students who negatively responded to the question acting as the reference group.

Academic related factors –Study program, *study field*, and *how study tuition was paid* were included as factors related to the student's academic context. The distinction was made between first-year and non-first-year students within the bachelor study program, resulting in 5 categories: first-year

bachelor (ref.), not first-year bachelor, master, or another program. The study field was operationalized according to the ISCED study field categorization (UNESCO, 2006). The categories of 'how study tuition was paid' are (1) by parent(s) (ref.), (2) self-paid, (3) (partly) by a scholarship, (4) bank loan, (5) not relevant (because higher education is paid by the government) and (6) other.

COVID-19 related factors – *Perceived infection risk* was measured by a scale ranging from 0 (very unlikely) to 10 (very likely to get (re)infected by COVID-19). *Change in the financial situation* was based on the difference in answers on the statement *'I had sufficient financial resources to cover my monthly costs*' (a) considering their situation before the COVID-19 outbreak and (b) during the week prior to filling out this survey and consists of three categories: (1) worse than before COVID-19; (2) similar (ref.), and (3) better than before the COVID-19 outbreak. The variable' *change in housing situation*' was constructed by combining the information on where the student lived prior to the COVID-19 outbreak and in the week prior to filling out the survey. The answer combinations were grouped into four categories: (1) no change in the living situation: staying with parents (ref.), (2) no change in the living situation: staying in a student residence or renting an apartment/house with other students or alone, (3) change in the living situation: moved to parents, and (4) change in the living situation: moved to an apartment/house with other students or alone. Whether the students experienced c*hanges in their social contacts* was assessed by asking students whether they had more or less contact with family and friends (both online/offline) since the implementation of COVID-19 measures ('similar' was taken as the reference category)

We also controlled for whether they *had or currently have COVID-19* (confirmed by a test or by a health care professional) and adjusted our results for *the number of days between the implementation of the first lockdown measures within students' country* (obtained from Hale et al. (2020) *and the moment of filling out the survey.*

COVID-19 related academic stress and satisfaction – Respondents were asked to what degree they agreed with the statements: (1) My university/college workload has significantly increased since the COVID-19 outbreak; (2) I know less about what is expected of me in the different course

modules/units since the COVID19 outbreak; (3) I am concerned that I will not be able to successfully complete the academic year due to the COVID-19 outbreak; (4) The change in teaching methods resulting from the COVID -19 outbreak has caused me significant stress; (5) The university/college provides poorer quality of education during the COVID-19 outbreak as before; (6) The university/college has sufficiently informed me about the changes that were implemented due to the COVID -19 outbreak; (7) I am satisfied with the way my university/college has implemented protective measures concerning the COVID -19 outbreak; (8) I feel I can talk to a member of the university/college staff (e.g., professor, student counsellor) about my concerns due to the COVID -19 outbreak. Based on the results of a factor analysis of eight items (varimax rotation). Two dimensions were retrieved: academic stress (including items 1-4) and academic satisfaction (including items 5-8). Cronbach's alpha of both scales is 0.7. Country-specific reliability indices are reported elsewhere (Van de Velde et al., 2020).

Country-level variables – Unemployment rate (of the active working population 24-75 in 2019, (OECD, 2020)) was included as an indicator of the socioeconomic condition of a country. To assess the stringency of measures taken in response to COVID-19 for each country, the University of Oxford coronavirus government response tracker (OxCGRT) stringency index (T. Hale et al., 2021) was included. This index captures the governments' different policies taken during the pandemic. For all countries, the measurement scores of the Oxford data were at the national level, except for the USA and Canada. There we have opted for the regional measures corresponding to the region of the participating HEI: New Jersey and Quebec (also available in the Oxford data). Scores were included for the corresponding weeks during which our sample participated in the survey.

To take the strength and timing (in relation to the survey period) of the pandemic into account, we calculated the *country's level of excess mortality (p-score)* during the period of the data collection, using data from Eurostat (Eurostat, 2020) or national or regional statistics bureaus, and additionally used this variable to construct a '*timing of the survey in relation to the peak*' variable with three

categories (0) before the peak, (1) during and (2) after the peak of the first wave of the COVID-outbreak.

2.3 Statistical analysis

First, we present mean levels of depressive symptoms along with the 95% confidence interval per country (Figure 1). As the students were clustered in HEIs (N=125), which were again clustered in countries (N=26), a hierarchical three-level model was constructed with individual-level variables and control variables at the country level. The multilevel analyses applied a stepwise procedure. Model 1 included students' sociodemographic, socioeconomic and social support characteristics, the academic-related factors, and the control variables at the country level (youth unemployment rate, stringency of implemented COVID-19 protective measures, and epidemiological context). In Model 2, the impact of the COVID-19 related stressors (high-risk perception, change in social contact with friends and family, deterioration of the financial situation, and change in the living situation) were estimated. At the same time, we controlled for whether the student was or had been infected with COVID-19 and for the time since the implementation of the first lockdown measures. In Model 3, academic stress and satisfaction were added. Random slopes for the COVID-19-related variables were estimated separately, and if significant, reported in the text. As a last step, we investigated the extent to which the variance in depressive symptoms was predicted by (1) non-COVID-19 related factors, which include the group of sociodemographic, socioeconomic, and social support indicators, as well as the group of academic characteristics and (2) the COVID-19 related factors, which include both the factors that describe changes in the student's life due to COVID-19, as well as levels of academic stress and satisfaction during the COVID-19 pandemic. The unique variances were calculated for each country by comparing the explained variance of the full model, including all the predictive and control factors, with the explained variance of a model that includes only the general characteristics (and subgroups therein) or the COVID-19 related stressors (and subgroups therein). Possible common variances between these variable groups are not captured in the unique variances. Because the C19 ISWS is non-representative for the HEI population, with particularly female students and students above 25 years

of age being overrepresented, additional sensitivity analyses were performed by replicating the multilevel results using a separate sample of male and female students and using a sample that excludes students aged 26 or older. These results are reported in Appendix D. Data preparation and descriptive statistics were done in SPSS 26, and the multilevel analyses were performed in MLWIN.

3. Results

As Figure 1 shows, substantial variation was found in the mean level of depressive symptoms across the various countries. The lowest levels of depressive symptoms were reported in the Nordic countries (Iceland, Norway, Sweden, Denmark, and Finland) and France, while the highest mean levels of depressive symptoms were reported in Turkey, South Africa, Spain, and the USA.

[Figure 1 about here]

Turning to our multilevel results (Table 1), the variance decomposition of the null model (not presented) showed that 5.8% of the variance of depressive symptoms was explained by differences between countries and only 2.2% by differences within countries between HEIs (8.0% higher level variance).

After including students' sociodemographic, - economic, and social support characteristics in Model 1, and controlling for countries' youth unemployment rate, stringency of implemented COVID-19 measures, and epidemiological context, the higher-level variance was reduced to 4.7%. The results of Model 1 show that female students, students younger than age 26, students with a migration background (first and second generation), and single students or students in a complicated relationship (compared to students in a steady relationship) experienced more depressive symptoms. Students who were not able to borrow money from anyone or only from 1 or 2 persons and students who struggled with financial problems before the COVID-19 outbreak reported more depressive symptoms. Not having a confidant was strongly related to more depressive symptoms. In addition, students with a bank loan reported more depressive symptoms, while students who had paid their study tuition by themselves reported fewer depressive symptoms, both in comparison to students for whom the

parents paid their studies. Students of Social Sciences reported fewer depressive symptoms than those enrolled in Humanities and Arts fields, but more than students in any of the other study fields.

After adding the COVID-19 related stressors, the higher-level variance was further reduced to 3.3% in Model 2 and 3.2% in Model 3. Students infected with COVID-19, with a higher level of perceived risk of infection and those who were worried about becoming infected showed more depressive symptoms. In addition, students who found it more challenging to cope with their financial resources since the COVID-19 outbreak reported more depressive symptoms as well. Students who moved back home since the COVID-19 outbreak reported more depressive symptoms than those who were already living at home. An additional analysis examining more detailed changes in the living situation (results not reported in the table) showed that students who lived alone (before and since the COVID-19 outbreak; 8.5% of the students) (b=0.440[0.136]) reported more depressive symptoms than those who stayed at their family home. Students who reported to have had less social contact with their family and friends since the COVID-19 outbreak experienced more depressive symptoms. However, also students with more contact with friends showed more depressive symptoms than those with a similar amount of social contact.

[Table 1 about here]

The last model (Model 3) showed that students who experienced more academic stress reported more depressive symptoms, and an inverse (but less strong) relation was observed for academic satisfaction. The effect of age was no longer significant, while that of study program became significant: Master students reported significantly more depressive symptoms compared to first-year bachelor students when taking academic stress into account. An additional analysis (results not reported in the table) revealed that first-year Bachelor students reported more academic stress and less academic satisfaction compared to Master students, which indicates that academic stress and satisfaction were suppressing the difference in depressive symptoms between students in Bachelor and Master programs. Also, the relations of 'change to home' (vs. stay home) with more depressive

symptoms and 'self-paid the study tuition' (vs. paid by parents) with fewer depressive symptoms were no longer significant.

Of the macro-control variables, only the stringency index was statistically significant (and limited to model 1): In countries with stricter implemented COVID-19 protective measures, the level of depressive symptoms of students was higher as well. Finally, we re-estimated Model 3 with random slopes for each of the COVID-19 related stressors (separately), but none were significant.

Results from Table 2 show that our model was able to explain between 25.6% in Russia and 45.4% in Spain, with the USA as an outlier where the model explained 56.6% of the total variance. The decomposition of this explained variance, however, showed substantial cross-national variation in the relevance of the factor-groups. Overall, the COVID-19 related stressors explained a relatively larger portion of the variance in depressive symptoms compared to the non-COVID-19 related characteristics. Only in Cyprus, Iceland, Israel, Spain, and Sweden could a larger proportion of the explained variance uniquely be attributed to the non-COVID-19-related factors. Within this group of factors, the sociodemographic, socioeconomic, and social support factors carried a heavier weight in explaining variations in depressive symptoms, as did the students' academic characteristics.

The unique variance of the COVID-19 related factors ranged between 8.7% in Israel and 25.3% in the USA. While a substantially larger proportion of the variance was related to academic stress and satisfaction, with the exception of Israel, where levels of variation in academic stress and satisfaction explain less of the variation in depressive symptoms than the other COVID-19 related stressors.

4. Discussion

Our study examined the frequency and correlates of depressive symptoms in higher education students during the first wave of the COVID-19 pandemic. Using the comprehensive C19 ISWS dataset, we established significant cross-national variation in depressive symptoms among higher-education students. The lowest levels of depressive symptoms were found in the Nordic countries, while the highest levels of depressive symptoms were found in the student samples from Turkey, South Africa,

Spain, and the USA. The comparison of our results with the available cross-national research on mental health in the general population reveals substantially more depressive symptoms in the C19 ISWS sample but confirms a similar pattern of cross-national variation in the general and student populations before the pandemic (Bracke et al., 2020; Bromet et al., 2011; Van de Velde et al., 2010a). This suggests that many of the factors that explained mental health disparities prior to the COVID-19 outbreak continued to play out during the pandemic. For example, in Turkey, where we find the highest levels of depressive symptoms, students were already confronted with existing political instabilities (World Bank, 2020) and declining economic conditions (ILO, 2021b). However, Turkey was also among the countries of which the government provided the least amount of financial aid to its citizens during the COVID-19 period (IMF, 2021), resulting in one of the strongest increases in youth unemployment rates within Europe (ILO, 2021a). Moreover, the Turkish government's decisions regarding whether to close higher education were unclear and unstable, which may have reinforced feelings of uncertainty among students.

In a similar line, our study confirms the available research pointing to a higher risk of depressive symptoms in female students, students with fewer social support resources and in a more disadvantaged socioeconomic position, and among students with a migration background (Auerbach et al., 2016). Our finding that moving back to the parental home is distressing and is related to an increase in depressive symptoms was also established by Caputo (2020): both the backward step in the transition to independence and the intensified contact in the context of COVID-19 confinement could explain these relationships. At the same time, selection effects could have been at work, in that students whose mental health status was affected during the pandemic coped by moving back to their family home. In addition, the physical distancing rules caused a strong decline in social contact with friends, which can reinforce the risk of depressive symptoms, as these social contacts have been identified as an important resource in coping with stress in students (H. Liu et al., 2020a). Our study also confirms the relationship between financial stress and depressive symptoms as profusely demonstrated in general and student populations (Walsemann et al., 2015). This demands attention

to the repercussions of COVID-19 and the associated policy measures on students' financial situation in the mid to long term, particularly in countries with a pronounced imbalance between the costs of higher education and the capacity of students to shoulder increasing debt burdens (Goodnight et al., 2015).

We found that a substantial group of students reported academic stress in the context of the COVID-19 pandemic, which relates to more depressive symptoms. Students who reported higher levels of academic satisfaction, however, reported fewer depressive symptoms. This is in line with a recent study (Mostert & Pienaar, 2020), which demonstrated that low academic satisfaction is related to psychosocial difficulties. A higher level of academic stress and dissatisfaction accounts for the higher number of depressive symptoms, particularly in first-year Bachelor students. For students who are not yet familiar with the ins and outs of higher education, the COVID-19 pandemic seems to have exacerbated this uncertainty which was associated with higher levels of depressive symptoms. At the same time, when the results were adjusted for academic stress and academic satisfaction, Master students reported significantly more depressive symptoms, indicating that other sources of distress were also at play (e.g., job-seeking stress and uncertainty about the job market, lost career-building internships, difficulties in completing research projects). Further research should investigate which additional factors explain these elevated levels of distress in Master students.

Our finding that students in humanities and arts fields report more depressive symptoms is somewhat surprising. The available literature mainly focuses on high levels of distress among medical students (Dahlin et al., 2005). Only a limited number of studies make the comparison with other study fields but come to contradicting findings (Bunevicius et al., 2008; Reddy et al., 2018). Students in study fields with less favorable employment prospects, such as the humanities and arts, experience relatively more job-seeking stress and are more often in a vulnerable socioeconomic position (Oh & Kim, 2020; Quadlin, 2017). These factors may have been amplified during the COVID-19 pandemic, which is reflected in the partial nullification of the effect in the humanities and arts after adding the different

stressor groups to our models. In this respect, particularly students in Arts fields were confronted with their sector completely shutting down in most countries and with little prospect of reopening soon.

The decomposition of the explained variance showed that COVID-19 related factors, and in particular levels of COVID-19 related academic stress and satisfaction, explained a relatively larger proportion of the variance in depressive symptoms compared to the non-COVID-19 related stressors. The finding that COVID-19-related variables explained the largest proportion of the variance shows the importance of seeking appropriate ways to tackle the pandemic while minimizing the secondary effects on mental health (Masten & Motti-Stefanidi, 2020). Only when students themselves were infected with COVID-19 did we see a strong association between the pandemic and their mental health. When this was not the case, depressive symptoms were more strongly related to the pandemic's secondary effects, such as increased levels of financial worries and social isolation, than to the extent of the pandemic itself. The mitigation of these secondary effects should, therefore, be a priority within the student population. Future research should examine how other macro-societal factors (e.g., the types of COVID-19 protective measures that were imposed by the government and HEI) explain the cross-national variation in depressive symptoms, given the lack of a direct impact of the pandemic itself.

Our study has several limitations. First, because depressive symptoms were not assessed prior to the COVID-pandemic, we were unable to disentangle causal paths between depressive symptoms and social stressors, nor were we able to examine the degree to which depressive symptoms changed. As a result, elevated levels of depressive symptoms may have already been present prior to the COVID-19 pandemic. Second, the C19 ISWS made use of a convenience sample, both in terms of the selection of students, HEIs, and countries. Sample sizes were small in several countries (e.g., Israel, USA), or data were collected within only one HEI within certain countries (e.g., Slovakia, Sweden, USA). As a result, the C19 ISWS is not representative of the entire student population. In addition, bias cannot be excluded, as it may be likely that students who experienced stress due to the COVID-19 pandemic were also more likely to respond to our invitation to participate in the study than students who did not

experience stress. Students with a more disadvantaged socioeconomic background or limited access to the internet are generally less likely to participate in surveys, while female students are more likely to do so, to which the C19 ISWS is also subject. Readers should keep these limitations in mind when interpreting our results.

Nevertheless, our study identifies higher-education students as a vulnerable group during the COVID-19 pandemic. This study adds to a growing literature on the precarious situation of HEI students and young adults in general in contemporary society (Storrie et al., 2010). It confirms elevated levels of depressive symptoms in students during the pandemic. Students in a more disadvantaged socioeconomic position, with fewer social support resources and less experience in higher education, were particularly vulnerable during the COVID-19 pandemic. It shows that not the pandemic itself, but rather the pandemic's secondary effects relate to students' mental health. Our results enable HEIs to be better equipped to target groups that are at risk during a pandemic.

REFERENCES

Abdulghani, H.M., Sattar, K., Ahmad, T., & Akram, A. (2020). Association of COVID-19 Pandemic with undergraduate Medical Students' Perceived Stress and Coping. *Psychology research and behavior management,* 13, 871.

Abel, T. (2020). Presentation: Remarks on the gradient effect in Switzerland & concluding discussion. *University of Bern, Swiss*.

Aquilino, W.S. (2006). Family relationships and support systems in emerging adulthood.

Aristovnik, A., Keržič, D., Ravšelj, D., Tomaževič, N., & Umek, L. (2020). Impacts of the COVID-19 pandemic on life of higher education students: A global perspective. *Sustainability,* 12, 8438.

Arnett, J.J. (2014). *Emerging adulthood: The winding road from the late teens through the twenties*: Oxford University Press.

Aslan, H., & Pekince, H. (2020). Nursing students' views on the COVID-19 pandemic and their percieved stress levels. *Perspectives in psychiatric care*.

Auerbach, R.P., Alonso, J., Axinn, W.G., Cuijpers, P., Ebert, D.D., Green, J.G., et al. (2016). Mental disorders among college students in the World Health Organization world mental health surveys. *Psychological medicine,* 46, 2955-2970.

Blanco, C., Okuda, M., Wright, C., Hasin, D.S., Grant, B.F., Liu, S.-M., et al. (2008). Mental health of college students and their non–college-attending peers: Results from the national epidemiologic study on alcohol and related conditions. *Archives of general psychiatry,* 65, 1429-1437.

Bracke, P., Delaruelle, K., Dereuddre, R., & Van de Velde, S. (2020). Depression in women and men, cumulative disadvantage and gender inequality in 29 European countries. *Social Science & Medicine*, 113354.

Bromet, E., Andrade, L.H., Hwang, I., Sampson, N.A., Alonso, J., De Girolamo, G., et al. (2011). Cross-national epidemiology of DSM-IV major depressive episode. *BMC medicine,* 9, 90.

Buhl, H.M., & Lanz, M. (2007). Emerging adulthood in Europe: Common traits and variability across five European countries. Sage Publications Sage CA: Los Angeles, CA.

Bunevicius, A., Katkute, A., & Bunevicius, R. (2008). Symptoms of anxiety and depression in medical students and in humanities students: relationship with big-five personality dimensions and vulnerability to stress. *International Journal of Social Psychiatry,* 54, 494-501.

Buote, V.M., Pancer, S.M., Pratt, M.W., Adams, G., Birnie-Lefcovitch, S., Polivy, J., et al. (2007). The importance of friends: Friendship and adjustment among 1st-year university students. *Journal of adolescent research,* 22, 665-689.

Capano, G., Howlett, M., Jarvis, D.S., Ramesh, M., & Goyal, N. (2020). Mobilizing policy (in) capacity to fight COVID-19: Understanding variations in state responses. *Policy and Society,* 39, 285-308.

Caputo, J. (2020). Parental coresidence, young adult role, economic, and health changes, and psychological well-being. *Society and Mental Health,* 10, 199-217.

Chambel, M.J., & Curral, L. (2005). Stress in academic life: work characteristics as predictors of student well-being and performance. *Applied psychology,* 54, 135-147.

Cleary, M., Walter, G., & Jackson, D. (2011). “Not always smooth sailing”: mental health issues associated with the transition from high school to college. *Issues in mental health nursing,* 32, 250-254.

Cooke, R., Barkham, M., Audin, K., Bradley, M., & Davy, J. (2004). Student debt and its relation to student mental health. *Journal of Further and Higher Education,* 28, 53-66.

Dahlin, M., Joneborg, N., & Runeson, B. (2005). Stress and depression among medical students: A cross-sectional study. *Medical education,* 39, 594-604.

Dong, L., & Bouey, J. (2020). Public Mental Health Crisis during COVID-19 Pandemic, China. *Emerg Infect Dis,* 26.

Dundes, L., & Marx, J. (2006). Balancing work and academics in college: Why do students working 10 to 19 hours per week excel? *Journal of College Student Retention: Research, Theory & Practice,* 8, 107-120.

Etheridge, B., & Spantig, L. (2020). The gender gap in mental well-being during the Covid-19 outbreak: evidence from the UK. Institute for Social and Economic Research.

Eurostat. (2020). Weekly death statistics. Retreived September 9, 2020 from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Weekly_death_statistics&stable

Fisher, S. (1994). *Stress in academic life: The mental assembly line*: Open University Press.

Fry, F., Passel, J., & Cohn, D. (2020). A majority of young adults in the US live with their parents for the first time since the Great Depression. Washington, DC: Pew Research Center; 2020.

Goodnight, G.T., Hingstman, D., & Green, S. (2015). The student debt bubble: Neoliberalism, the university, and income inequality. *Journal of Cultural Economy,* 8, 75-100.

Hale, T., Angrist, N., Goldszmidt, R., Kira, B., Petherick, A., Phillips, T., et al. (2021). A global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker). *Nat Hum Behav,* 5, 529-538.

Hale, T., Petherick, A., Phillips, T., & Webster, S. (2020). Variation in government responses to COVID-19. *Blavatnik school of government working paper,* 31.

Hauschildt, K., Gwosc, C., Netz, N., & Mishra, S. (2015). *Social and Economic Conditions of Student Life in Europe: Synopsis of Indicators. Eurostudent V 2012-2015*: W. Bertelsmann Verlag.

Hayes, J.A., Chun-Kennedy, C., Edens, A., & Locke, B.D. (2011). Do double minority students face double jeopardy? Testing minority stress theory. *Journal of College Counseling,* 14, 117-126.

Hefner, J., & Eisenberg, D. (2009). Social support and mental health among college students. *American Journal of Orthopsychiatry,* 79, 491-499.

Hongbo, L., & Waqas, M.A. (2020). PSYCHOLOGICAL PREDICTORS OF ANXIETY IN RESPONSE TO THE COVID-19 PANDEMIC: EVIDENCE FROM PAKISTAN.

Hunt, J., & Eisenberg, D. (2010). Mental health problems and help-seeking behavior among college students. *Journal of adolescent health,* 46, 3-10.

Husky, M.M., Kovess-Masfety, V., & Swendsen, J.D. (2020). Stress and anxiety among university students in France during Covid-19 mandatory confinement. *Comprehensive Psychiatry,* 102, 152191.

Ibrahim, A.K., Kelly, S.J., Adams, C.E., & Glazebrook, C. (2013a). A systematic review of studies of depression prevalence in university students. *Journal of Psychiatric Research,* 47, 391-400.

Ibrahim, A.K., Kelly, S.J., & Glazebrook, C. (2013b). Socioeconomic status and the risk of depression among UK higher education students. *Social psychiatry and psychiatric epidemiology,* 48, 1491-1501.

ILO (2021a). Beyond unemployment: The impact of the pandemic on hours worked in Turkey. https://www.ilo.org/wcmsp5/groups/public/---europe/---ro-geneva/---ilo-ankara/documents/publication/wcms_766572.pdf.

ILO (2021b). Unemployment with advanced education (% of total labor force with advanced education). International Labour Organization, ILOSTAT database. Retrieved August 3, 2021 from https://ilostat.ilo.org/topics/unemployment-and-labour-underutilization/.

IMF. (2021). Additional spending and forgone revenue in response to the COVID-19 pandemic. Database of Country Fiscal Measures in Response to the COVID-19 Pandemic. Retrieved August 3, 2021 from https://www.imf.org/en/Topics/imf-and-covid19/Fiscal-Policies-Database-in-Response-to-COVID-19.

Kang, L., Ma, S., Chen, M., Yang, J., Wang, Y., Li, R., et al. (2020). Impact on mental health and perceptions of psychological care among medical and nursing staff in Wuhan during the 2019 novel coronavirus disease outbreak: A cross-sectional study. *Brain Behav Immun*.

Li, S., Wang, Y., Xue, J., Zhao, N., & Zhu, T. (2020). The Impact of COVID-19 Epidemic Declaration on Psychological Consequences: A Study on Active Weibo Users. *Int J Environ Res Public Health,* 17.

Liu, H., Zhang, M., Yang, Q., & Yu, B. (2020a). Gender differences in the influence of social isolation and loneliness on depressive symptoms in college students: a longitudinal study. *Social psychiatry and psychiatric epidemiology,* 55, 251-257.

Liu, X., Liu, J., & Zhong, X. (2020b). Psychological State of College Students During COVID-19 Epidemic. *Available at SSRN 3552814*.

Loades, M.E., Chatburn, E., Higson-Sweeney, N., Reynolds, S., Shafran, R., Brigden, A., et al. (2020). Rapid Systematic Review: The Impact of Social Isolation and Loneliness on the Mental Health of Children and Adolescents in the Context of COVID-19. *Journal of the American Academy of Child & Adolescent Psychiatry*.

Mallman, M., & Lee, H. (2017). Isolated learners: young mature-age students, university culture, and desire for academic sociality. *International Journal of Lifelong Education,* 36, 512-525.

Marmot, M. (2005). Social determinants of health inequalities. *Lancet,* 365, 1099-1104.

Masten, A.S., & Motti-Stefanidi, F. (2020). Multisystem resilience for children and youth in disaster: Reflections in the context of COVID-19. *Adversity and resilience science,* 1, 95-106.

Mojtabai, R., Olfson, M., & Han, B. (2016). National trends in the prevalence and treatment of depression in adolescents and young adults. *Pediatrics,* 138, e20161878.

Mostert, K., & Pienaar, J. (2020). The moderating effect of social support on the relationship between burnout, intention to drop out, and satisfaction with studies of first-year university students. *Journal of Psychology in Africa,* 30, 197-202.

OECD (2018). The resilience of students with an immigrant background: Factors that shape well-being. *OECD Review of Migrant Education*.

OECD. (2020). Unemployment rate by age group (indicator). doi: 10.1787/997c8750-en (Accessed on 07 September 2020).

Oh, B., & Kim, C. (2020). Broken promise of college? New educational sorting mechanisms for intergenerational association in the 21st century. *Social Science Research,* 86, 102375.

Quadlin, N. (2017). Funding sources, family income, and fields of study in college. *Social Forces,* 96, 91-120.

Quintini, G. (2015). Working and learning: A diversity of patterns.

Radloff, L.S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied psychological measurement,* 1, 385-401.

Reddy, K.J., Menon, K.R., & Thattil, A. (2018). Academic stress and its sources among university students. *Biomedical and Pharmacology Journal,* 11, 531-537.

Richardson, T., Elliott, P., Roberts, R., & Jansen, M. (2017). A longitudinal study of financial difficulties and mental health in a national sample of British undergraduate students. *Community mental health journal,* 53, 344-352.

Savarese, G., Curcio, L., D'Elia, D., Fasano, O., & Pecoraro, N. (2020). Online university counselling services and psychological problems among Italian students in lockdown due to Covid-19. Healthcare (p. 440): Multidisciplinary Digital Publishing Institute.

Sestito, L.A., & Sica, L.S. (2014). Identity formation of Italian emerging adults living with parents: A narrative study. *Journal of adolescence,* 37, 1435-1447.

Shen, H., & Ziderman, A. (2009). Student loans repayment and recovery: international comparisons. *Higher education,* 57, 315-333.

Singhal, D., & Vijayaraghavan, P. (2020). A descriptive Study of Indian General Public's Psychological responses during COVID-19 Pandemic Lockdown Period in India *World Pandemic Research Network: Societal Impacts and Aftermath of Covid-19: A Global Searchable Directory,* Working paper.

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. *Journal of medical internet research,* 22, e21279.

Stallman, H.M. (2010). Psychological distress in university students: A comparison with general population data. *Australian Psychologist,* 45, 249-257.

Stathopoulou, T., Avrami, L., Mouriki, A., Cavounidis, J., & Kostaki, A. (2018). Self-reported depression among migrant and native populations in Greece in times of crisis. *European journal of public health,* 28, 32-37.

Storrie, K., Ahern, K., & Tuckett, A. (2010). A systematic review: students with mental health problems—a growing problem. *International journal of nursing practice,* 16, 1-6.

UNESCO (2006). International Standard Classification of Education: ISCED 1997. *http://www.uis.unesco.org/Library/Documents/isced97-en.pdf*.

UNESCO. (2020). UNITWIN/UNESCO Chair Holders Institutional Responses to COVID-19. Prelimenary results of a survey conducted in April 2020. .

Van De Velde, S. (2013). Gender and depression in Europe: analyzing gender differences in depression from a cross-national comparative perspective. Ghent University.

Van de Velde, S., Bracke, P., & Levecque, K. (2010a). Gender differences in depression in 23 European countries. Cross-national variation in the gender gap in depression. *Social science & medicine,* 71, 305-313.

Van de Velde, S., Bracke, P., Levecque, K., & Meuleman, B. (2010b). Gender differences in depression in 25 European countries after eliminating measurement bias in the CES-D 8. *Social Science Research,* 39, 396-404.

Van de Velde, S., Buffel, V., Bracke, P., Van Hal, G., Somogyi, N., Willems, B., et al. (2020). The COVID-19 International Student Well-being Study *Scandinavian Journal of Public Health*.

Walsemann, K.M., Gee, G.C., & Gentile, D. (2015). Sick of our loans: Student borrowing and the mental health of young adults in the United States. *Social Science & Medicine,* 124, 85-93.

Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C.S., 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.

Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., McIntyre, R.S., et al. (2020b). A longitudinal study on the mental health of general population during the COVID-19 epidemic in China. *Brain, behavior, and immunity*.

Wege, N., Li, J., Muth, T., Angerer, P., & Siegrist, J. (2017). Student ERI: Psychometric properties of a new brief measure of effort-reward imbalance among university students. *Journal of Psychosomatic Research,* 94, 64-67.

World Bank, W. (2020). Political stability And absence of violence/terrorism: Estimate. World Bank Database - Worldwide Governance Indicators Dataset, Dataset ID: 3. Retrieved August 3, 2021 from https://datacatalog.worldbank.org/political-stability-and-absence-violenceterrorism-estimate.

Tables and figures

Table 1: Depressive symptoms regressed on general characteristics and COVID-19 related stressors, controlled for youth unemployment rate, stringency index, and epidemiological context.

	Model 1			Model 2			Model 3		
	B	SE.		B	SE.		B	SE.	
Intercept	7.842	0.550	***	7.083	0.453	***	7,601	0,416	***
Non-COVID-19 related factors									
Sociodemographic factors									
Gender (ref. men)									
Women	0.980	0.079	***	0.719	0,077	***	0,627	0,073	***
Age (ref. 17-25 years old)									
Age 26 or older	-0.531	0.091	***	-0.466	0.093	***	-0,096	0,087	
Migrant background (ref. no)									
1ste generation migrant background	0.292	0.100	**	0.185	0.099		0,230	0,094	*
2nd generation migrant background	0.467	0.111	***	0.360	0.108	***	0,309	0,102	***
Relationship status (ref. single)									
In a steady relationship	-0.397	0.070	***	-0.526	0.070	***	-0,602	0,066	***
it is complicated	1.659	0.159	***	1.528	0.154	***	0,120	0,145	***
Socioeconomic and social support factors									
Education parents (ref. high)									
Low educational level	0.035	0.130		-0.082	0.126		-0,108	0,118	
Moderate educational level	0.001	0.079		-0.086	0.077		-0,132	0,072	
Able to borrow money from (ref. 5 or more persons)									
no person	2.332	0.135	***	1.968	0.132	***	1,502	0,124	***
1 to 2 persons	1.683	0.091	***	1.444	0.089	***	1,190	0,084	***
3 to 4 persons	1.071	0.082	***	0.945	0.080	***	0,862	0,075	***
Financial situation before COVID-outbreak (ref. not struggling)									

Struggling with current resources	1.140	0.132	***	1.300	0.134	***	0,897	0,126	***
Confidant available (ref. yes)									
No	2.990	0.103	***	2.749	0,101	***	2,330	0,095	***
Academic-related factors									
Study tuition paid by (ref. parents)									
Self-paid	-0.243	0.122	*	-0.229	0,119		-0,146	0,112	
Scholarship	-0.135	0.137		-0.114	0.133		-0,098	0,125	
Bank loan	0.455	0.151	**	0.370	0,146	*	0,323	0,138	*
Not relevant	0.053	0.121		0.140	0.117		0,257	0,110	*
Other	-0.192	0.171		-0.167	0,167		-0,025	0,157	
Study program (ref. first-year bachelor)									
Bachelor program (not in the first-year)	0.103	0.089		0.133	0.087		-0,021	0,082	
Master program	-0.104	0.086		-0.073	0.084		0,208	0,079	**
Other program	-0.325	0.224		-0.303	0.217		-0,297	0,205	
Study field (ref. social sciences)									
Education	-0.533	0.142	***	-0.545	0,138	***	-0,545	0,130	***
Humanities and Arts	0.343	0.118	**	0.383	0.114	***	0,454	0,107	***
Science	-0.273	0.112	*	-0.138	0,109		-0,093	0,103	
Engineering, Manufacturing, and Construction	-0.333	0.149	*	-0.251	0.144		-0,352	0,136	**
Agriculture	-0.347	0.291		-0.252	0.283		-0,327	0,266	
Health and Welfare	-0.675	0.098	***	-0.620	0.095	***	-0,623	0,089	***
Services	-0.760	0.264	**	-0.686	0.256	**	-0,681	0,241	**
Other	0.046	0.216		0.084	0.210		0,053	0,197	
COVID-19 related factors									
Days since start of (soft)lockdown				-0.016	0.006	*	-0.012	0.006	*
Infected with COVID-19 (ref. no)									
Yes				1.428	0.296	***	1.141	0,279	***
COVID-19 risk perception				0.050	0.014	***	0,040	0,013	**
Worries to get infected with COVID-19				0.242	0.012	***	0,193	0,012	***

	Change in financial situation (ref. similar as before)									
	Worse during covid				1.427	0.075	***	0,869	0,071	***
	Better during Covid				0.216	0.132		0,101	0,124	
	Change in family contact (on- and offline) (ref. about the same)									
	More				0.143	0,075		0,129	0,070	
	Less				0.640	0,089	***	0,469	0,084	***
	Change in friends contact (on- and offline) (ref. about the same)									
	More				0.427	0,101	***	0,291	0,095	**
	Less				0.804	0,076	***	0,609	0,072	***
	Change in living situation (ref. no change: stay with parents)									
	No change: living with others or alone				-0.097	0.095		-0.078	0,089	
	Change to home (with parents)				0.198	0.089	*	0,079	0,084	
	Change to living with others or alone				-0.089	0.162		-0,164	0,152	
	Academic satisfaction							-0,171	0,011	***
	Academic stress							0,356	0,009	***
Macro control variables										
	Youth unemployment rate	0.035	0.037		0.031	0.030		0,020	0,028	
	Stringency index	0.045	0.021	*	0.020	0.019		-0,001	0,017	
	Excess mortality	-1.982	1.775		-2.390	1.427		-1,149	1,309	
	Timing survey (ref. during Covid-19 peak)									
	Before the COVID-19 peak	0.508	0.750		0.443	0.602		0,521	0,552	
	After the COVID-19 peak	0.479	0.584		0.406	0.468		0,383	0,429	
Variance										
	Country level	0.790	0.263		0.462	0.167		0,382	0,140	
	HEI level	0.273	0.079		0.234	0,070		0,205	0,061	
	Individual level	21.625	0.216		20.373	0.204		18,047	0,180	
	ICC	4.685			3.303			3,150		
	-2LL		118996772			117783849			115345096	

** p<0.050 ** p<0.01 ***p<0.001; ICC intra class correlation; -2LL = -2 loglikelihood (measure of model fit)*

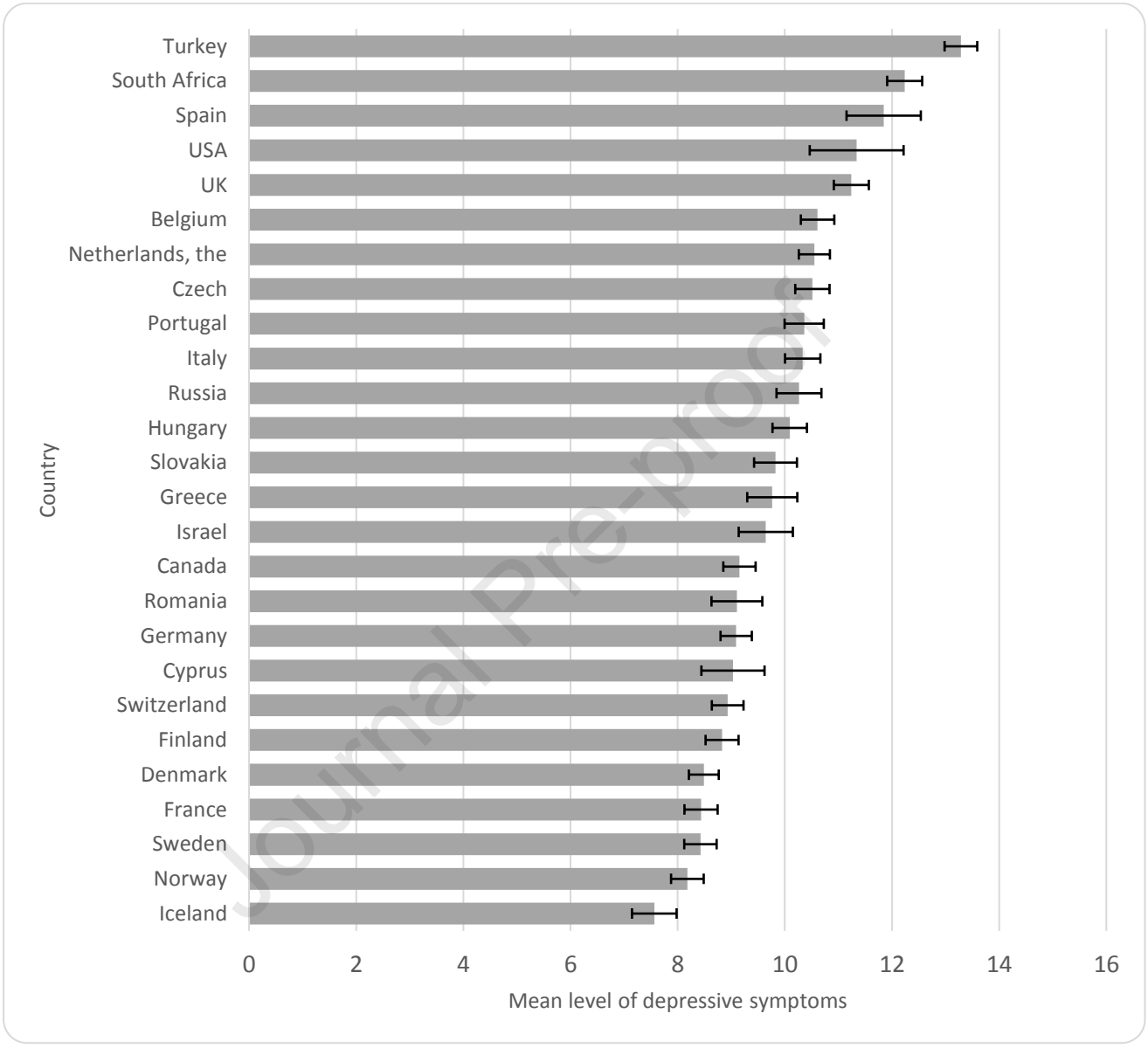
Table 2: Explained total variance and unique variance by factor groups.

		Unique variance (R^2)					
	Total	non COVID-19 related[a]			COVID-19 related[b]		
	All factor groups	total (i & ii)[a]	sociodemo-graphic, socioeconomic and social support factors[i]	academic related[ii]	total (iii & iv)[b]	covid-19 related stressors[iii]	academic stress and satisfaction[iv]
Belgium	30.7	6.3	4.3	1.4	19.5	3.0	13.8
Canada	28.2	9.8	5.4	3.1	13.2	2.8	8.7
Czech Rep	31.1	10.3	8.0	1.7	16.5	3.3	11.5
Cyprus	39.0	16.0	8.3	6.4	14.0	2.8	9.8
Denmark	33.6	9.3	7.4	1.3	16.1	2.5	12.0
Finland	33.3	10.5	7.1	2.6	16.3	3.9	10.4
France	27.8	8.0	6.8	1.2	15.5	3.5	9.6
Germany	27.9	10.1	6.5	3.2	12.3	1.2	10.0
Greece	30.1	10.2	6.1	3.7	17.3	3.9	11.7
Hungary	26.8	7.2	5.3	1.3	13.4	2.4	9.4
Iceland	29.8	16.5	11.7	3.7	9.6	3.8	3.9
Israel	38.2	19.2	14.6	3.8	8.7	6.7	1.7
Italy	26.2	11.0	8.9	1.6	12.0	2.4	8.5
The Netherlands	31.4	8.6	5.0	3.4	16.6	2.7	12.0
Norway	34.7	6.7	5.5	0.8	20.8	3.2	14.5
Portugal	29.3	11.4	5.9	4.2	12.3	3.7	7.8
Romania	36.0	12.6	9.9	2.1	15.6	5.1	8.3
Russia	25.6	8.8	4.8	3.7	14.7	4.3	9.8
Slovakia	30.0	10.9	9.4	0.6	15.8	1.9	12.4
South Africa	33.5	9.8	7.8	1.7	16.6	3.5	9.9
Spain	45.4	21.9	13.6	5.8	17.5	4.7	10.8
Sweden	27.9	12.3	9.5	2.1	11.9	3.0	7.3
Switzerland	38.4	13.0	10.6	2.0	15.5	3.0	10.5
Turkey	29.3	9.7	7.2	2.0	12.5	2.9	8.0
UK	32.4	7.8	6.4	1.6	15.4	5.2	7.6
USA	56.6	18.9	11.8	8.0	25.3	7.8	15.8
Total	29.1	7.9	6.1	1.2	15.4	2.8	10.3

[a] [i](gender, age, migration status, relationship status, education parents, borrow money from, financial situation before COVID, trust person available) and [ii](study tuition paid by, study program, study field)

[b] [iii](days since lockdown, infected by COVID, risk perception, worries about Covid, change in financial status, change in contact with friends and family, change in livings situation) and [iv](academic stress and satisfaction)

Figure 1: Mean level of depressive symptoms along with 95% confidence intervals ranked by country (scale range: 0-24).



Appendix

Appendix A. Selection of survey period per country

There was temporal variation of the stringency index within countries' period during which the data was collected, but this variation was not enough for the inclusion of an additional level 'country*period (=week)' in the multilevel analyses to model 'time'. As a result, we decided to limit the survey period per country in order to restrict the data to a period with relatively stable policy measures. Only respondents who participated in the survey during this selected survey period were included. The application of the basic rule for the selection of the survey period per country means in practice that, for some countries, we could use the entire survey period (Czech, Iceland, South Africa, USA [New Jersey]), while for most countries, the survey period was shortened by 1 to 4 weeks (Belgium (1 week excluded), Canada [Quebec] (1), Cyprus (2), Denmark (2), Finland (1), France (5), Germany (4), Greece (3), Israel (2), Italy (3), Portugal (1), Romania (4), Slovakia (2), Norway (2), Spain (4), Switzerland (3), Turkey (1), and UK (2). If the basic rule could not be applied because the first two weeks were not stable in terms of policy measures, we selected a later period during the period of data collection. This was the case for Hungary, the Netherlands, and the UK. The selection of sample period resulted for some countries in exclusion of an HEI, as these institutions had launched their survey at a different time period than the other participating HEIs within that country:

Appendix B. Overview of the selected survey period per country

	Week																			
Week	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Date							27/04-03/05	04/05-10/05	11/05-17/05	18/05-24/05	25/05-31/05	01/06-07/06	08/06-14/06	15/06-21/06	22/06-28/06	29/06-05/07	06/07-12/07	13/07-19/07	20/07-26/07	24/07-02/08
Belgium				P																
Canada							P													
Czech Republic																P				
Cyprus			p																	
Denmark			P																	
Finland				P																
France									P											
Germany			P																	
Greece				P																
Hungary		P																		
Iceland				P																
Israel								P												
Italy			P																	
The Netherlands		P																		
Norway				P																
Portugal		P																		
Romania																P				
Russia								P												
Slovakia													P							
South Africa																		P		
Spain						P														
Sweden					p															
Switzerland					P															
Turkey			P																	
UK	P																			
USA					P															

Legend: Green = selected survey period; Red = unselected and excluded from the survey period; P = peak of first C19 wave based on excess mortality rate

Appendix C. Descriptive statistics with percentage distribution (%) for categorical variables, and mean ($\bar{X}$) and standard deviation (s.d.) for linear variables.

	N	%	$\bar{X}$	s.d.
Sociodemographic factors				
Gender				
Men	5239	26.1		
Women	14864	73.9		
Age				
17-25 years	15739	78.3		
26 years or older	4364	21.7		
Migrant background				
No migrant background	15002	74.6		
1ste generation migrant background	2974	14.8		
2nd generation migrant background	2127	10.6		
Relation status				
Single	9470	47.1		
In a steady relationship	9676	48.1		
It is complicated	957	4.8		
Socioeconomic and social support factors				
Parental educational level				
Low	1698	8.4		
Moderate	5720	28.5		
High	12685	63.1		
Able to borrow money from				
no person	1604	8.0		
1 to 2 persons	4134	20.6		
3 to 4 persons	5123	25.5		
5 or more persons	9242	46.0		
Financial situation before COVID-19 outbreak				
Not struggling with current resources	18688	93.0		
Struggling with current resources	1415	7.0		
Confidant available				
No	2596	12.9		
Yes	17507	87.1		
Academic-related factors				
Study tuition paid by:				
Parents	5166	25.7		
Self-paid	2542	12.6		
Scholarship	1700	8.5		
Bank loan	1747	8.7		
Not relevant	7935	39.5		
Other	1013	5.0		

Study program				
First-year bachelor program	10909	54.3		
Bachelor program (not first year)	3840	19.1		
Master program	4880	24.3		
Other program	474	2.4		
Study field				
Social Sciences	5710	28.4		
Education	1448	7.2		
Humanities and Arts	2343	11.7		
Sciences	2701	13.4		
Engineering, manufacturing, construction	1337	6.7		
Agriculture	284	1.4		
Health and Welfare	5425	27.0		
Services	340	1.7		
Other	515	2.6		
COVID-19 related factors				
Days since start of (soft)lockdown			62.9	22.2
Infected with COVID-19				
No	19865	98.8		
Yes	238	1.2		
COVID-19 risk perception (0-10)			4.0	2.5
Worries to get covid (0-10)			4.1	3.0
Change in financial situation				
Worse during COVID-19 pandemic	5725	28.5		
Similar as before	12961	64.5		
Better during COVID-19 pandemic	1417	7.0		
Change in family contact				
More	7151	35.6		
About the same	8735	43.5		
Less	4217	21.0		
Change in friends contact				
More	3136	15.6		
About the same	5913	29.4		
Less	11054	55.0		
Change in living situation				
No change: stayed with parents	5725	28.5		
No change: living with others or alone	7756	38.6		
Change to home (with parents)	5661	28.2		
Change to living with others or alone	961	4.8		
Academic satisfaction (0-16)			9.1	3.2
Academic stress (0-16)			9.5	3.9

Appendix D.

The multilevel results based on a sample that excludes students aged 26 years or older did not differ from the sample covering all age groups. When replicating the results by men and women separately, we found that effect of migration status and of being enrolled in an educational study field no longer held in the male sample. All other effects were similar in direction and strength. In addition, sensitivity analyses were done with 'mean level of excess mortality two weeks prior and after the survey' and 'hospital beds per thousand' instead of 'mean level of excess mortality during the data collection'; as well as with 'real GDP growth rate'; but these macro control variables were not significantly related to depressive symptoms and none of these changes had an impact on the already obtained results.

Depressive symptoms in higher education students during the first wave of the COVID-19 pandemic. An examination of the association with various social risk factors across multiple high- and middle-income countries.

Highlights

- Exacerbated depressive symptoms are observed among students during the COVID-19 pandemic
- Depressive symptoms in students vary across countries during the COVID-19 pandemic
- Depressive symptoms related more strongly to COVID-19 than to non-COVID-19 stressors