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Article

University students' sense of coherence, future worries and mental health: findings from the German COVID-HL-survey

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Summary

Early-on in the COVID-19 pandemic when universities were closed as part of the nation-wide public health response to the COVID-19 outbreak, studying and student life significantly changed. Based on limited evidence the aim of this study was to explore the relationship between sense of coherence (SoC), future worries and mental health outcomes among German university students during the early phase of the pandemic. A cross-sectional online survey with $n = 14\,916$ participants was carried out by inviting all private and public universities in Germany. All data were analysed using univariate, bivariate and multivariate statistics. Findings indicate a low and very low wellbeing for 38% of university students. Moreover, 29% reported being affected by at least two health complaints more than once week. Both health outcomes follow a social gradient and could be more frequently observed for respondents with lower subjective social status and female students. Regression analysis revealed significant association between the SoC dimensions and wellbeing (OR: 1.2−2.03) as well as health complaints (OR: 1.58−1.71). A high level of future worries was associated with low/very low wellbeing (OR: 2.83) and multiple health complaints (OR: 2.84). Based on the results, the public health response to the pandemic and university health promotion should therefore consider student mental health as an important target within their policy and action frameworks.

Key words: COVID-19, university students, sense of coherence, psychosomatic complaints, wellbeing

BACKGROUND

In response to the COVID-19 outbreak, Germany has undertaken strict measures since March 2020 including closure of borders, public and cultural facilities, stay-home and restraining orders, physical distancing, and mask wearing (Wieler and Gottschalk, 2020). These measures help mitigating the wider health effects, but are accompanied by unintended consequences with adverse effects on society, such as negative economic impact (e.g. rise in unemployment rate and loss of income), social and home isolation and transport restrictions (Douglas *et al.*, 2020). While health consequences

concern both physical (Di Gennaro *et al.*, 2020) and psychosocial (Torales *et al.*, 2020) outcomes, the latter are currently overlooked but critical to consider as part of the COVID-19 response strategies (Ahorsu *et al.*, 2020). Fear of COVID-19 has shown to be associated with psychological distress, perceived vulnerability and life satisfaction (Ahorsu *et al.*, 2020; Satici *et al.*, 2020). People from lower socioeconomic background or people that use social media more frequently were more often affected by COVID-related stress and adverse mental health outcomes (Gao *et al.*, 2020; Torales *et al.*, 2020). Findings from a cross sectional study in 31 Chinese provinces revealed a prevalence of depression of 48% and of anxiety of 23% (Gao *et al.*, 2020). Studies from the USA, Canada and the Philippines found that stress caused by COVID-19 was associated with symptoms of anxiety and depression (Montano and Acebes, 2020; Taylor *et al.*, 2020).

With regard to higher education, the COVID-19 pandemic has not only affected the university at the organizational level but also the individual level (Raaper and Brown, 2020). On the individual level, university students can be regarded as a vulnerable group as they face challenging circumstances and new experiences in their life course. Earlier studies showed that university students are particularly vulnerable for mental health problems (Storrie *et al.*, 2010) and that female students and those with lower subjective social status (SSS) are more susceptible for mental and physical health problems (Stallman, 2010; Pedrelli *et al.*, 2016; Diehl *et al.*, 2020). Although potential adverse health effects seem self-evident and worth investigating, studies on student mental health and anxiety in times of COVID-19 are limited. In their study with over 7000 college students, Cao *et al.* (2020) could show that 25% of students suffered from mild to severe symptoms of anxiety. Empirical research conducted in university students in Russia, Belarus, Nigeria and France found that female students were more likely to experience fear, anxiety, depression and distress in relation to COVID-19 (Essadek and Rabeyron, 2020; Rakhmanov and Dane, 2020; Reznik *et al.*, 2020). Moreover, Son *et al.* (Son *et al.*, 2020) observed a self-reported increase of stress and anxiety due to the COVID-19 outbreak in 71% of the college students surveyed. Stressors that contributed to mental health problems included worries about their own health and of their loved ones, disruptions to sleeping patterns and decreased social interactions due to physical distancing. These results indicate the need to investigate the mental health situation of university students in times of COVID-19 and to evaluate predictors, in particular those that enable positive mental health outcomes.

As emphasized by van den Broucke (van den Broucke, 2020) much of the current debate focuses on risk factors and disease prevention while a resource oriented (health promoting) perspective is rarely applied. Sense of coherence (SoC) as the main concept of the salutogenesis theory represents such a health resource that can be characterized as a global orientation towards viewing one's life as comprehensible, manageable and meaningful (Eriksson and Mittelmark, 2017). As a coping capacity, SoC is particularly relevant in stressful and demanding situations such as the COVID-19 pandemic. Available evidence suggests that a high SoC in university students is associated with fewer daily hassles (Hochwälder and Saied, 2018), better mental health (Knowlden *et al.*, 2013) and a health promoting lifestyle (Binkowska-Bury and Januszewicz, 2010).

Hence, the purpose of this study is to explore the relationship between SoC, future worries, and mental health outcomes among university students in Germany during the early phase of the coronavirus pandemic.

METHODS

Study design

This survey is part of a large scale international university students survey that was launched in mid-March 2020 investigating digital health literacy, health information seeking, future time perspectives and mental health outcomes among university students (Dadaczynski *et al.*, 2020, www.covid-hl.org). A national cross-sectional survey was conducted in Germany including a non-randomized sample of university students. In order to address as many students as possible, all private and state universities in Germany ($n = 392$ universities including a total of 2.9 million students) were invited to participate in the study by email. For this purpose, all official university bodies, such as dean's offices, faculty secretariats and student boards were asked to forward the invitation letter to their students. The study gained ethical approval by Bielefeld University ethics committee (No. EUB 2020-053) and was conducted from 25 March to 17 April 2020. The survey was administered electronically using the Enterprise Feedback Suite survey tool by Questback. Participation was voluntary, and anonymity was assured. Upon entering the survey site, participants were presented with information regarding the aims and the background of the survey, including data protection and ethical matters. After checking a consent box at the

bottom of the page, participants were directed to the questionnaire.

Measures

SoC and future anxiety served as independent variables while psychological wellbeing and health complaints were considered as dependent health variables in this study.

Regarding SoC, we used the work-related SoC instrument (Vogt *et al.*, 2013; Bauer *et al.*, 2015) including nine bipolar adjectives that could be rated on a seven-point semantic differential scale. As the survey did not focus on a specific context and university students do not necessarily pursue regular employment, the original context (work-setting) has been changed by adjusting the initial question ('How do you personally find your current life situation in general?' instead of 'How do you personally find your current job resp. work situation in general'). Due to their generic nature, no adjustments were made to the items. While the dimension 'comprehensibility' was measured with four items (e.g. structured—unstructured), the dimension 'manageability' comprised two items (e.g. easy to influence—impossible to influence) and the subscale 'meaningfulness' three items (e.g. insignificant—significant). The internal consistency (Cronbach's α) of two subscales and the overall SoC scale was acceptable to good ($0.71<\alpha<0.81$). Only the subscale 'manageability' reached a reliability coefficient of $\alpha < 0.7$ which however was considered as sufficient due to the low number of items included (Loewenthal, 2001). For further regression analyses, all mean scores have been dichotomized based on the median-split (1 = low level of SoC, 0 = high level of SoC).

Future anxiety, understood as a state of uncertainty, worry, and concern of unfavourable changes in a more remote personal future, has been operationalized by the dark future scale (Zaleski et al., 2019). This instrument is a short version of the Future Anxiety scale (Zaleski, 1996) including five items that could be rated on a 7-point Likert scale from 0 (decidedly false) to 6 (decidedly true). One example item is: 'I am afraid that the problems which trouble me now will continue for a long time'. In addition, three further items from the original Future Anxiety Scale were included, which were selected based on the fit with the purpose of the study (e.g. 'I fall into a state of tension and uneasiness when I think of my future affairs.'). Cronbach's α for this scale was 0.82. With regard to regression analysis we dichotomized this variable using median-split (1 = high level of future anxiety, 0 = low level of future anxiety).

University student's psychological wellbeing as dependent variable has been assessed using the WHO-5 wellbeing index (Bech, 2004). WHO-5 is a tool to assess self-perceived wellbeing for a given period of time (past 2 weeks) through five positively worded items (e.g. over the last 2 weeks… I have felt active and vigorous). It is conceptualized as a uni-dimensional measure with each item be rated on a six-point Likert scale ranging from 0 (at no time) to 5 (at all the time). According to the scale developer the raw score for each item has been multiplied by four resulting in a transformed scale from 0 (lowest wellbeing) to 100 (highest wellbeing). Internal consistency for this scale was good ($\alpha = 0.81$). Existing cut-off values suggest a low wellbeing for scores $\leq$50, while values $\leq$28 indicate a depression, which requires further diagnostic clarification (Topp *et al.*, 2015). For subsequent regression analyses we merged the two groups with scores $\leq$50 into one group (1 = low/very low wellbeing).

To assess psychosomatic complaints we used a symptom checklist originally developed and used for the Health Behaviour in School-aged Children (HBSC) Study (Haugland and Wold, 2001). Respondents were asked how often they experienced eight symptoms (e.g. headache, stomach-ache, feeling dizzy) during the previous 6 months with possible answers ranging from 0 (rarely or never) to 4 (about every day). Although previous studies suggest that the scale reflects two dimensions, the scale can be considered as measuring a uni-dimensional latent trait of psychosomatic complaints. The internal consistency (Cronbach's α) for this scale was acceptable (0.79). We created two groups to identify respondents having two or more symptoms more than once a week (1 = multiple health complaints) and those with less frequent symptoms (0 = single health complaints) (Inchley *et al.*, 2020).

Finally, a number of sociodemographic information were included such as sex (male, female, diverse), age ($\leq$20 years, 21–23 years, 24–26 years, $\geq$27 years), study course (Bachelor, Master, other) and SSS. SSS was assessed using the German version of the MacArthur Scale which included a ladder with 10 steps (Adler *et al.*, 2000; Hoebel *et al.*, 2015). Respondents were asked to position themselves at the step that best reflected their status on the social hierarchy with higher values indicating a higher SSS. According to previous studies, respondents were categorized into three groups: low SSS (1–4), medium SSS (5–7) and high SSS (8–10) (Schricker *et al.*, 2020).

Study population and weighting

For this study, university students enrolled at a private or state university were eligible to participate. To

increase the homogeneity of the sample, respondents who indicated that they were not currently enrolled as students at a German university were excluded from the sample ($n = 245$). After further plausibility check and adjustment for incorrect data, the final sample contained $n = 14\,916$ participants. The majority of the unweighted sample were female students with 66.8%, Bachelor students with 69.5% and 21- to 23-year-old respondents with 38%. With regard to the SSS more than two third reported a middle SSS while 17% belonged to a low and 14% to a high SSS group.

To control for selection bias caused by the convenience sampling procedure we used weighting to adjust the sample distribution to the characteristics of the general population of German university students. Based on data provided by the Federal Statistical Office via the GENESIS database, data could be weighted for gender and desired study degree (Table 1).

Data analyses

We first calculated descriptive statistics (M, SD, %). Subsequently, bivariate analyses were performed with the dependent variables and all independent and sociodemographic variables using chi square tests (χ^2). For all analyses p-values <0.05 were considered statistically significant. However, due to the large sample size, the strength of the association was calculated using a normalized version of the χ^2 statistic test for nominal scaled variables (Cramer V). According to Cohen (Cohen, 2013), the strength of each association was interpreted as an effect size measure using the following conventions: ≥ 0.1 (small), ≥ 0.3 (medium), ≥ 0.5 (large). Pairwise correlation coefficients provided a first impression regarding the associations of the independent and dependent variables, but they neglect the influence of other variables. Multiple binary logistic regression analyses were used to examine the association of all explanatory variables with low/very low levels of psychological wellbeing and multiple health complains by odds ratio (OR) and its respective 95% confidence interval (95% CI). All predictors were included block-wise with Model 1 only including sociodemographic variables, Model 2 including sociodemographic variables and all SoC dimensions and Model 3 comprising future anxiety and all previous predictors. The estimated fit of the regression models was provided by Nagelkerke's R^2 and χ^2 tests were used for testing the significance of the different models. We used IBM SPSS Statistics 23 for all statistical analyses.

RESULTS

Descriptive and bivariate analyses

With regard to psychological wellbeing, 62% of students reported a sufficient level of wellbeing, while more than one third showed a low or very low wellbeing, including 12.4% with very low wellbeing. Stratified by sociodemographic characteristics significant differences could be found for gender, age and SSS (Table 2). However, taken the strength of the association (Cramer V) into account, small effect sizes could be identified only for SSS with respondents reporting a low SSS were more often affected by a low and very low wellbeing (low SSS: 47.3%, middle SSS: 37.3%, high SSS: 28.6%, $\chi^2(1) = 179.06$, $p < 0.01$, $V = 0.11$).

More than a quarter of the respondents' (28.9%) reported being affected by at least two health complaints more than once week. Chi square tests revealed a

Table 1: Unweighted and weighted characteristics of study participants ($n = 14.974 - 14.895$)

Item	Category	Frequency (n)	Percentage, % unweighted	Percentage, % weighted
Gender	Male	4.938	33.2	51.5
	Female	9.957	66.8	48.5
Age (years)	≤20	2.661	17.8	17.7
	21–23	5.700	38.1	36.9
	24–26	3.523	23.6	23.9
	≥27	3.069	20.5	21.5
Study course	Bachelor	10.405	69.5	69.4
	Master	2.815	18.8	18.7
	Other (e.g. PhD)	1.751	11.7	11.9
Subjective social status	Low	2.544	17.0	17.3
	Medium	10.288	68.7	67.7
	High	2.141	14.3	15.0

Table 2: Wellbeing and health complaints of university students differentiated by sociodemographic characteristics

	Low/very low wellbeing % (*n*)	Sufficient wellbeing % (*n*)	Multiple health complaints % (*n*)	Single health complaints % (*n*)
Gender	$\chi^2 = 99.86$ (1), $p < 0.001$, $V = 0.08$		$\chi^2 = 214.21$ (1), $p < 0.001$, $V = 0.12$	
Male	33.8 (2.574)	66.2 (5.031)	23.6 (1.789)	76.4 (5.781)
Female	41.8 (2.998)	58.2 (4.171)	34.6 (2.467)	65.4 (4.666)
Age	$\chi^2 = 9.25$ (2), $p < 0.05$, $V = 0.03$		$\chi^2 = 3.61$ (2), n.s.	
≤20 years	37.2 (975)	62.8 (1.644)	29.9 (781)	70.1 (1.827)
21–23 years	36.7 (1.999)	63.3 (3.452)	29.0 (1.572)	71.0 (3.851)
24–26 years	39.8 (1.403)	60.2 (2.123)	29.3 (1.029)	70.7 (2.479)
≥27 years	37.3 (1.190)	62.3 (1.969)	27.8 (873)	72.2 (2.270)
Study program	$\chi^2 = 3.83$ (3), n.s.		$\chi^2 = 21.47$ (3), $p < 0.001$, $V = 0.04$	
Bachelor	38.2 (3.920)	61.8 (6.331)	30.0 (3.060)	70.0 (7.135)
Master	36.5 (1.012)	63.5 (1.758)	25.6 (705)	74.4 (2.050)
Other (e.g. PhD)	36.6 (641)	63.4 (1.112)	28.0 (491)	72.0 (1.261)
Subjective social status	$\chi^2 = 179.06$ (4), $p < 0.001$, $V = 0.11$		$\chi^2 = 155.99$ (4), $p < 0.001$, $V = 0.10$	
Low	47.3 (1.203)	52.7 (1.339)	38.5 (976)	61.5 (1.558)
Middle	37.3 (3.733)	62.7 (6.272)	27.8 (2.768)	72.2 (7.181)
High	28.6 (636)	71.4 (1.587)	23.1 (512)	76.9 (1.706)
Total	37.7 (5.572)	62.3 (9.202)	28.9 (4.256)	71.1 (10.447)

χ^2, chi square; df, degrees of freedom; *p*, significance; *V*, Cramer's V; n.s., not significant; %, percent; *n*, frequency.

Table 3: Means, standard deviations and correlations of dependent and independent variables

	M	SD	1	2	3	4	5	6	7
1. Psychological wellbeing	55.21	19.82	(0.81)						
2. Health complaints	2.11	0.70	−0.49**	(0.79)					
3. SoC: Comprehensibility	4.51	1.10	0.46**	−0.36**	(0.70)				
4. SoC: Manageability	4.34	1.33	0.26**	−0.18**	0.50**	(0.60)			
5. SoC: Meaningfullness	5.02	1.27	0.41**	−0.28*	0.44**	0.33**	(0.80)		
6. SoC: Overall	4.64	0.96	0.49**	−0.36**	0.86**	0.71**	0.77**	(0.81)	
7. Future Anxiety	2.49	1.09	−0.46**	0.45**	−0.44**	−0.26**	−0.39	−0.48	(0.82)

Note: $n = 14.6073 - 14.815$, internal consistency (α) estimates are on the diagonal.
*$p < 0.05$; two-tailed tests.
**$p < 0.01$.

significant difference with a higher percentage of multiple health complaints found for female compared with male students ($\chi^2(1) = 214.21$, $p < 0.01$, $V = 0.12$). While no significant difference could be found with regard to age and desired study degree, students with a low SSS were more frequently affected by multiple health complaints compared with all other SSS groups ($\chi^2(4) = 155.99$, $p < 0.01$, $V = 0.10$).

Table 3 shows the descriptive statistics (*M*, SD) for all study variables. Comparing the dimensions of the SoC shows the highest mean value for the meaningfulness subscale ($M = 5.02$, $SD = 1.27$), while for the subscale manageability the lowest mean value could be identified ($M = 4.34$, $SD = 1.33$). Stratified analyses (data not shown) revealed significant gender differences with males reporting a higher comprehensibility (males = 4.64, females = 4.36, $p < 0.01$) and manageability (males = 4.50, females = 4.16, $p < 0.01$). Moreover, respondents with lower SSS also indicated a lower SoC for all subdimensions. Differences could also be observed with regard to future anxiety: females (males = 2.34, females = 2.65, $p < 0.01$) and university students with lower SSS ($2.20 < M < 2.82$, $p < 0.01$) were more often affected by worries about their future.

As depicted in Table 3, all independent and dependent variables were weakly to moderately correlated in

Table 4: Multiple binary logistic regression analysis for low wellbeing among university students

	Low wellbeing (≤50)					
	Model 1 (R^2 = 0.03, χ^2 = 294.12(8)**)		Model 2 (R^2 = 0.19, χ^2 = 1938.67 (11)**)		Model 3 (R^2 = 0.25, χ^2 = 2496.48 (12)**)	
	OR	95% CI	OR	95% CI	OR	95% CI
Gender (n = 12 532)						
Male	1.00	–	1.00	–	1.00	–
Female	**1.42****	**1.33–1.53**	**1.26****	**1.17–1.36**	**1.17****	**1.08–1.27**
Age (n = 12 532)						
≥27 years	1.00	–	1.00	–	1.00	–
24–26 years	1.10	1.00–1.22	1.01	0.90–1.13	1.02	0.90–1.15
21–23 years	0.94	0.86–1.04	**0.86***	**0.77–0.96**	**0.88***	**0.79–0.98**
≤20 years	0.98	0.88–1.09	0.95	0.83–1.08	0.98	0.86–1.12
Study program (n = 12 532)						
Other (e.g. PhD)	1.00	–	1.00	–	1.00	–
Master	1.01	0.89–1.14	1.00	0.86–1.16	0.96	0.82–1.12
Bachelor	1.10	0.99–1.22	1.06	0.94–1.20	1.00	0.82–1.14
Subjective social status (n = 12 532)						
High	1.00	–	1.00	–	1.00	–
Middle	**1.44****	**1.30–1.59**	**1.23****	**1.10–1.38**	**1.19****	**1.06–1.34**
Low	**2.20****	**1.95–2.49**	**1.51****	**1.31–1.73**	**1.39****	**1.20–1.60**
SoC: comprehensibility (n = 12 532)						
High			1.00	–	1.00	–
Low			**2.61****	**2.40–2.84**	**2.03****	**1.86–2.22**
SoC: managebility (n = 12 532)						
High			1.00	–	1.00	–
Low			**1.25****	**1.15–1.36**	**1.20****	**1.10–1.31**
SoC: meaningfulness (n = 12 532)						
High			1.00	–	1.00	–
Low			**2.42****	**2.22–2.63**	**2.03****	**1.86–2.22**
Future anxiety (n = 12 532)						
Low					1.00	–
High					**2.83****	**2.61–3.08**

χ^2, chi square; OR, odds ratio; CI, confidence interval; R^2, Nagelkerke's R^2
**$p < 0.01$.

the expected direction. While the SoC was positively ($0.26 < r < 0.46$) and future anxiety was negatively ($r = -0.46$) associated with wellbeing, the correlations with health complaints point in the opposite direction (SoC: $-0.18 < r < -0.36$; future anxiety: 0.45). Highest intercorrelations could be found for the overall SoC with its subdimensions ($0.71 < r < 0.86$). To avoid multicollinearity, we excluded the overall SoC from further regression analyses.

Multivariate analyses

Table 4 shows a series of multiple binary regression models for low/very low wellbeing. In Model 1 significant associations between low/very low wellbeing and female students (OR: 1.42, 95% CI: 1.33–1.53) and SSS (middle SSS = OR: 1.44, 95% CI: 1.30–1.59; low SSS = OR: 2.20, 95% CI: 1.95–2.49) could be observed. These relationships remain similar across all models, albeit to a lesser extent. Included in Model 2, we observed a

2.61-fold increased likelihood of low/very low wellbeing for university students with low level of comprehensibility (95% CI: 2.40–2.84). Respondents with lower manageability and meaningfulness showed a higher OR for a low/very low wellbeing (manageability = OR: 1.25, 95% CI: 1.15–1.36; meaningfulness = OR: 2.42, 95% CI: 2.22–2.63) compared with the reference groups, respectively. When added in the final model, we found a 2.83-fold increased probability for a low/very low wellbeing for respondents reporting a high level of future anxiety (95% CI: 2.61–3.08). All SoC dimensions remained in significant association with the dependent variable. Nagelkerke's R^2 showed a value of 0.25, indicating that 25% the variation of the dependent variable was explained by the explanatory variables in Model 3.

The results of the regression models with multiple health complaints as dependent variable are summarized in Table 5. In Model 1, gender and SSS were significantly associated with multiple health complaints. Female students had a 1.74-fold increased risk for at

Table 5: Multiple binary logistic regression analysis for multiple health complaints among university students

	≥2 health complaints more than once a week					
	Model 1 (R^2 = 0.04, χ^2 = 395.11 (8)**)		**Model 2 (R^2 = 0.12, χ^2 = 1.132.90 (11)**)**		**Model 3 (R^2 = 0.18, χ^2 = 1648.97 (12)**)**	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Gender (n = 12 475)						
Male	1.00	–	1.00	–	1.00	–
Female	**1.74***	**1.62–1.87**	**1.67****	**1.54–1.81**	**1.57****	**1.44–1.71**
Age (n = 12 475)						
≥27 years	1.00	–	1.00	–	1.00	–
24–26 years	1.08	0.97–1.21	1.00	0.89–1.13	1.02	0.90–1.15
21–23 years	1.01	0.91–1.11	0.94	0.84–1.05	0.96	0.86–1.08
≤20 years	1.06	0.94–1.20	1.03	0.91–1.18	1.06	0.92–1.22
Study program (n = 12 475)						
Other (e.g. PhD)	1.00	–	1.00	–	1.00	–
Master	0.92	0.80–1.06	0.92	0.79–1.07	0.86	0.73–1.01
Bachelor	**1.14***	**1.01–1.27**	1.13	1.00–1.28	1.09	0.95–1.24
Subjective social status (n = 12 475)						
High	1.00	–	1.00	–	1.00	–
Middle	**1.21****	**1.09–1.35**	1.06	0.94–1.20	0.98	0.87–1.11
Low	**2.04****	**1.80–2.36**	**1.59****	**1.38–1.83**	**1.40****	**1.21–1.62**
SoC: comprehensibility (n = 12 475)						
High			1.00	–	1.00	–
Low			**1.90****	**1.74–2.08**	**1.58****	**1.44–1.74**
SoC: manageability (n = 12 475)						
High			1.00	–	1.00	–
Low			1.06	0.97–1.16	0.99	0.91–1.09
SoC: meaningfulness (n = 12.475)						
High			1.00	–	1.00	–
Low			**2.03****	**1.86–2.21**	**1.71****	**1.56–1.88**
Future anxiety (n = 12 532)						
Low					1.00	–
High					**2.84****	**2.60–3.11**

χ^2, Chi square; OR, odds ratio; CI, confidence interval; R^2, Nagelkerke's R^2
$^{**}p < 0.01$.

least two health complaints more than once a week (95% CI: 1.62–1.87). Moreover, reporting a middle SSS or low SSS were associated with a 1.21-fold (95% CI: 1.09–1.35) and 2.04-fold (95% CI: 1.80–2.36) higher likelihood of showing low/very low wellbeing. Except for students with middle SSS, these relationships remain significant in Models 2 and 3, albeit with lower odds. When all SoC dimensions were entered in Model 2, significant associations could be observed for comprehensibility (OR: 1.90, 95% CI: 1.74–2.08) and meaningfulness (OR: 2.03, 95% CI: 1.86–2.21) but not for manageability. In the final model, future anxiety proofed to be another significant predictor which increased the likelihood for multiple health complaints by a factor of 2.84 (95% CI: 2.60–3.11). Nagelkerke R^2 for the final model was 0.18, indicating that 18% of the variance was explained by the independent variables.

DISCUSSION

Early-on in the pandemic when universities were closed, the pandemic crisis created a stressful situation in most individuals, spreading insecurity, mental stress, and fear. The purpose of this research was to explore the relationship between SoC, future worries and mental health outcomes among German university students during the early stage of the coronavirus pandemic.

Our results show that almost 38% of the university students reported to have lower wellbeing, including 12% of respondents who showed indications for depression, which need further diagnostic examination. In addition, 29% of the students reported being affected by multiple health complaints more than once a week. The findings of this study showed that future anxiety as well as SoC was unequally distributed among students with different social background. In relation to future anxiety, our results are similar to earlier studies that show gender differences with females being more affected by fear of COVID-19 (Rakhmanov and Dane, 2020; Reznik *et al.*, 2020). However, a study on fear and anxiety of COVID-19 in university students in China could not find any gender differences but similarly shows that indicators on social status such as family income stability served as protective factors (Cao *et al.*, 2020).

We could identify gender and SSS differences in relation to mental health, while female students and respondents with lower SSS were more often affected by low wellbeing and multiple health complaints. Lower SoC levels and higher levels of future anxiety were found to be significant predictors of mental health. Based on the cross-sectional nature of this study we are not able to conclude that the COVID-19 pandemic and associated circumstances were the main influencing factors regarding differences in mental health outcomes. Comparing our findings to earlier studies is important, yet previous studies have mostly used different mental health instruments, making it difficult to compare the results with pre-pandemic research findings. One German study that has been conducted before the COVID-19 pandemic found similar frequencies for health complaints with 27.6% of university students reporting multiple health complaints (Schricker *et al.*, 2020). However, when interpreting the results, it should be noted that the study has been carried out at the beginning of the first wave of the pandemic and that psychological problems became more important as the pandemic progressed. Longitudinal results among UK students showed that psychological wellbeing significantly decreased and perceived stress increased over the course of 6 months (two surveys before and two after the UK lockdown) (Savage *et al.*, 2020). Further findings from the COVID-HL network from Australia revealed a low or very low wellbeing for 65% of the university students (Dodd *et al.*, 2021). Those reporting negative overall learning experience and COVID-19 having a huge impact on the study were more often affected with low wellbeing.

While behavioural aspects are understood to be a key prevention and protection strategy to contain and slow down the spread of the virus (Michie *et al.*, 2020), the behavioural approach must be supported by structural public health interventions designed to meet student public health needs during the pandemic and beyond. Students' capabilities, such as their SoC, health literacy and health knowledge might help them to cope with challenges related to the pandemic. Strengthening student SoC should be considered as an important strategy for mental health promotion in universities. Based on our results, comprehensibility and meaningfulness seemed important predictors for wellbeing and health complaints. The SoC dimension of comprehensibility refers to the extent to which internal and external stimuli are cognitively perceived as clear and ordered information. Other results from our survey revealed that almost one third of the university students reported problems in finding the information on the coronavirus they are looking for, while more than 40% expressed difficulties in assessing the reliability of health related information (Dadaczynski *et al.*, 2021). In other words, a significant proportion of university students do not perceive external information stimuli as clear and ordered, which also calls for structural activities on high quality information provision. Meaningfulness, on the other hand reflects an individual's perception that demands

represent challenges worthy of one's commitment and investment. This motivational component could be particularly important in the context of the COVID-19 pandemic which is characterized by conflicting information and limited possibilities of individual, i.e. self-determined action. Compared with manageability, the ability to deal with uncertainties and maintain an optimistic attitude is particularly important.

Independently from being knowledgeable and capable of applying health behaviours, students may experience difficulties when accessing resources, interacting with university staff only online, seeking for help and services, and applying the recommendations provided by health authorities. Mental health promotion should be implemented and designed eligible to serve face-to-face and digital interventions needs of students. These can be sustained through university services, but since it is rather unrealistic that universities can provide professional mental health services on a large scale to all students, especially during an emergency need, linking university and external mental health providers should be considered (Storrie *et al.*, 2010). In this context, it is of critical importance to apply community-based health promotion strategies in order to empower organizations and staff and strengthen their capacity to function properly (van den Broucke, 2020). In addition, campaigns and information strategies can be used to raise awareness for these services (Storrie *et al.*, 2010) and strengthen student's knowledge and mental health literacy. Since a large proportion of young adults have a high media affinity and also use digital media to a great extent, greater use should be made of digital interventions to promote mental health. Systematic reviews of randomized controlled trials show that e-mental health interventions have small but statistical significant effects on depression, anxiety and stress (Harrer *et al.*, 2019; Bolinski *et al.*, 2020). While focussing on students, university and academic staff should not be overlooked as they have an important role to play during the pandemic and themselves may suffer from stress by the university closures, transitioning and engagement in digital teaching, motivating their students to continue learning and studying, and additional administrative work related to changed working environment and challenges (Sahu, 2020).

Limitation

When interpreting the results of our study, several limitations need to be considered. Although all German universities were invited to participate in the study which resulted in a fairly high sample size, this sample is not representative, and the results cannot be generalized. As already emphasized, the cross-sectional design does not allow to interpret the associations as causal. Even if most students basically have access to the Internet, it must be considered that at the early stage of the coronavirus outbreak in Germany, the internet connection has reached its capacity limits. This may have made participation more difficult, especially for respondents living in already digitally underdeveloped regions, which increases the probability of a selection bias.

CONCLUSION

Since COVID-19 has caused a global threat to health and wellbeing, university students are highly affected by stress, anxiety and future worries. The evidence generated by this survey shows that student wellbeing and mental health in general should be monitored carefully during pandemics with a specific focus on the needs of female students and students with low SSS and SoC. Universities should provide health promoting measures at their campuses as recommended in the Okanagan Charter for health promoting universities (Okanagan, 2015), with a specific focus on student mental health promotion and holistic setting approaches.

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