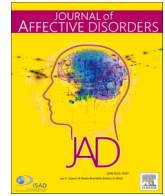




Contents lists available at ScienceDirect

Journal of Affective Disorders

journal homepage: www.elsevier.com/locate/jad

Research paper

Associations of university student life challenges with mental health and self-rated health: A longitudinal study with 6 months follow-up

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ARTICLE INFO

Keywords:

University students
Mental health
Academic stress
Psychological distress
Study-life balance

ABSTRACT

Background: Mental health problems are highly prevalent among university students. Stress due to student life challenges may be a risk factor for poorer health. This study investigates to what extent student life challenges and changes therein are associated with mental health and self-rated health.

Methods: In a longitudinal study with 568 Italian university students mental health was assessed using the Mental Health Inventory-5 (MHI-5) and self-rated health with a single item from the Short Form 36 Health Survey (SF36) (score ranges: 0-100) at baseline and at six months follow-up. Student life challenges were investigated using six subscales (score ranges: 1-4) of the Higher Education Stress Inventory (HESI). A between-within linear regression model was used to investigate whether a higher exposure to life challenges was associated with poorer health (between individuals) and whether changes in student life challenges were associated with changes in health (within individuals).

Results: Higher exposure to student life challenges was associated with poorer mental health (b ranging from -5.3 to -10.3) and self-rated health (b ranging from -3.1 to -9.6). An increase in student life challenges within individuals was associated with poorer mental health and self-rated health, in particular for high workload (b up to -5.9), faculty shortcomings (b up to -5.7), and unsupportive climate (b up to -5.6).

Discussion: Exposure to student life challenges and changes therein are associated with university students' health. Our findings suggest that student life challenges may be a target for interventions to improve mental health and self-rated health among university students.

1. Background

Mental health problems are a leading cause of health loss worldwide (Global Health Data Exchange, n.d.; Kessler et al., 2009; Vigo et al., 2016). Persons with mental health problems have an increased risk of comorbidities and of early mortality (Barth et al., 2004; Plana-Ripoll et al., 2019; Stein et al., 2019). The onset of mental health problems is often during the first three decades of life, in the time individuals are involved in their education (Kessler et al., 2009, 2007). Mental health problems among university students are highly prevalent (Auerbach et al., 2019; Quek et al., 2019; Rotenstein et al., 2016), and their prevalence significantly increased during the past decades (Benton et al., 2003; Lipson et al., 2019). The burden of mental health problems on university students is reflected in negative educational and health

outcomes. Students experiencing mental health problems have worse academic performance (Andrews and Wilding, 2004; Hysenbegasi et al., 2005; Stewart et al., 1999). Mental health problems are a risk factor for suicide, which represents a leading cause of death among young adults, including students, in Western countries (Forte et al., 2021). Younger generations were found to be more stressed than the older ones (American Psychological Association, 2018). Stress may be a key factor in the high risk of mental health problems among students, but a more comprehensive analysis of the stressful components of university students' life is needed to identify targets for interventions to improve mental health among students and prevent adverse health outcomes.

The term stress itself is vague and used with broad meanings in epidemiological, psychological and biological research (Cohen et al., 2016). Life challenges (demands and/or threats) have the potential to be

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<https://doi.org/10.1016/j.jad.2021.09.057>

Received 8 February 2021; Received in revised form 30 August 2021; Accepted 16 September 2021

Available online 23 September 2021

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perceived as stressful by individuals, but the actual experience of stress depends both on the characteristics of the challenge (e.g. source, intensity, duration) and on individual characteristics (e.g. coping strategies, resilience, values, beliefs) (Cohen et al., 2016). In this frame, stress is the result of the mismatch between the characteristics of the challenges and the individual resources needed to face them (Cohen et al., 2016; Demerouti et al., 2001).

University students face a wide range of student life challenges, which can be university-unrelated or university-related (Beiter et al., 2015; Hill et al., 2018). Among the student life challenges unrelated to university, several studies found associations between financial pressure and lack of social support with poorer students' mental health (Andrews and Wilding, 2004; Beiter et al., 2015; Richardson et al., 2017; Thompson et al., 2016). There are indications that university-related challenges such as high workload, insufficient feedback, negative relation with staff, lack of peer-support, fear of not acquiring the knowledge needed for the future profession, and lacking interest are associated with poorer students' mental health (Dahlin et al., 2005; Gibbons, 2010; Hill et al., 2018; Labrague et al., 2017; Rudman and Gustavsson, 2011; Stallman and Hurst, 2016).

Available studies have focused on stress due to university-related student life challenges and the effects on mental health. These studies mainly focused on the difference in exposure to student life challenges between students but not on changes in exposure to these challenges within individuals (Dahlin et al., 2005; Stallman and Hurst, 2016). A between-within model allows insights into differences between individuals and changes within individuals (Firebaugh et al., 2013). More knowledge about the differences in health between individuals with or without exposure to specific challenges may help to identify groups at higher risk. Insight into changes within individuals in exposure to student life challenges and the associations with health could show whether an increase in the exposure to a certain challenge would be associated with an actual deterioration in health. An additional advantage of the within-part of the between-within model is the removal of bias due to unmeasured time invariant variables. The model uses individuals as their own control, comparing them with themselves in a different moment in time.

The current study contributes to the literature by investigating the associations between students' university-related and university-unrelated life challenges and mental health and self-rated health using a between-within model in a longitudinal design with six months follow-up. This study aims to assess among Italian university students to what extent the exposure to student life challenges is associated with mental health and self-rated health (between-students comparison), and whether changes in the exposure to student life challenges are associated with changes in mental health and self-rated health (within-students comparison). Based on the literature, we hypothesize that (i) a higher exposure to student life challenges is associated with poorer mental health and poorer self-rated health, and that (ii) an increase in student life challenges is associated with a decrease in health.

2. Methods

2.1. Study design, study sample and recruitment

In this longitudinal study, data were collected at baseline (June 2019) and after six months follow-up (December 2019) among university students enrolled at the University of Bari, Italy. At the beginning of the academic year 2018-2019, 43,969 students were enrolled at the University of Bari. All students enrolled in any discipline were invited to participate through an email sent by the university, and promoted through web platforms commonly used by students of the University of Bari for academic-related announcements and social media. No compensation was offered to respondents. The email contained the link to the online questionnaire implemented in LimeSurvey®. Participants were informed about the study and were asked to provide digital

informed consent. At baseline, the questionnaire was opened 3064 times. The identification of duplicated Internet Protocols (IP) showed that on at least 98 devices the questionnaire was opened multiple times. Individuals were excluded from the study when they (a) did not provide digital informed consent (n=379), (b) did not complete information on mental health and self-rated health, student life challenges, and socio-demographics (n=942); (c) were not enrolled in a bachelor's, master's or a combined degree at baseline (n=42). Moreover, individuals were excluded when they (d) did not give permission to be contacted again for the follow up measurement (n=561); (e) did not complete follow-up information on mental health and self-rated health, student life challenges, and sociodemographics (n=560), or when they (f) were not enrolled in a bachelor's, master's or a combined degree at follow up (n=16). In total, from the 1777 respondents who completed the questionnaire at baseline, 568 respondents (32%) were included in this study [Supplementary file, Fig. A].

No ethical approval is required in Italy for observational studies as they are not defined as medical/clinical research, referring to the Italian law 211/2003. This study complied with the Declaration of Helsinki and with the Italian privacy law.

2.2. Measures

2.2.1. University students' health

Mental health and self-rated health were used as indicators for university students' health and measured by questionnaires at baseline and at six months follow-up.

Mental health. Mental health was measured with the Mental Health Inventory-5 (MHI-5), a short version of the MHI-38 (Berwick et al., 1991). The instrument was developed to investigate mental health problems such as anxiety, depression, and psychological distress and can be used as indicator of overall emotional functioning. The MHI-5 includes five items (Cronbach's $\alpha = 0.85$, in our sample at baseline) to investigate the presence of psychological well-being (2 items), and the absence of psychological distress (3 inverse-scored items) with Likert-scale answer categories ranging from (1) "all of the time" to (6) "none of the time". Firstly, a mean raw score was estimated. Secondly, the MHI-5 score was computed using the formula "MHI-5 = [(MHI-5_{mean raw score} - 1) * 100] / 5". The score ranged from 0 to 100, with higher scores indicating a better mental health (The Consortium of Multiple Sclerosis Centers Health Services Research, n.d.).

Self-rated health. Self-rated health (SRH) was measured using a single item from the Short Form 36 Health Survey (SF36) asking respondents to rate their health in general, with a Likert-scale ranging from (1) "very bad" to (5) "very good" (Ware and Sherbourne, 1992). The advantage of using this SRH item is that it offers respondents to give their own perception of health. The SRH has demonstrated to be strongly associated with mortality and morbidity (Bowling, 2005; Wuorela et al., 2020). To increase comparability with the mental health outcome, the score was rescaled in a 0-100 range with the formula "SRH = [(SRH - 1) * 100] / 4".

2.2.2. Student life challenges

Student life challenges refer to components of student life that could be perceived as stressful by students. Student life challenges were investigated using six subscales backtranslated from the Higher Education Stress Inventory (HESI) (Dahlin et al., 2005): faculty shortcomings, worries about future competence, unsupportive climate, high workload, low commitment, financial concerns. Faculty shortcomings (seven items, Cronbach's $\alpha=0.74$) concerns aspects such as the lack in opportunities to influence studies/curriculum, lack of stimulation towards personal development, the feeling that education is not preparing adequately for the future profession, and passive rather than active learning. Worries about future competence (three items, Cronbach's $\alpha = 0.67$) assesses the worries about stress and workload of the future profession. Unsupportive climate (five items, Cronbach's $\alpha = 0.65$)

concerns relationships among peers. High workload (three items, Cronbach's $\alpha = 0.68$) focuses on work-life balance and study pace. Low commitment (two items, Spearman's $r_s = 0.60$, in our sample) concerns the satisfaction with the chosen career, and financial concerns (two items, Spearman's $r_s = 0.49$ assesses the financial strain due to financing during education and future economical situation. The subscale insufficient feedback was excluded due to its poor psychometric properties ($r_s = 0.22$). Respondents were asked to express their general level of (dis)agreement with statements (e.g. studies control my life and I have little time for other activities) on a 4-point Likert-scale ranging from (1) "totally disagree" to (4) "totally agree". For each student life challenge a score was computed as a mean score of the items. A higher score indicates a higher exposure to the specific student life challenge.

2.2.3. Sociodemographics

Information concerning gender, age, living/studying location, educational program, study discipline, and academic progress were collected. With regard to gender, individuals could indicate whether they would define themselves as female, male, non-binary, or prefer to not declare. Individuals who indicated their gender as "non-binary" or "prefer not to declare" were merged as "others" due to the low numbers. Students were asked to indicate whether they studied in their hometown or somewhere else, and were classified into: (i) students studying in the city they lived in with their family before enrolling university ("studying in hometown"), (ii) students who travel on daily basis from another town to reach the university ("commuting for studying"), and (iii) students who moved to a new city to study ("moved for studying"). In Italy, the educational programme of university students includes three different types of degrees: (i) Bachelor's degree of the duration of three years, (ii) Master's degree of the duration of two years, and (iii) a combined degree for specific disciplines only with a duration of five (e.g. law) or six (e.g. medicine, dentistry) years combining the bachelor's and master's degree. Academic progress indicates whether students define themselves as "perfectly on track", "slightly late" or "delayed" with the study plan.

2.3. Statistical analyses

Exploratory analyses were performed to describe the characteristics of the study population. The main analyses were used to provide answers to the research questions. Supplementary analyses were performed to better frame the findings.

2.3.1. Exploratory analyses

Descriptive analyses were performed to describe the sociodemographic characteristics of the study population. Multiple linear regressions were performed to investigate the associations of baseline sociodemographic characteristics with mental health and self-rated health (Table 1).

An analysis of the variance (ANOVA) of the independent (student life challenges) and dependent variables (mental health and self-rated health) was performed to disentangle the variation between individuals from changes within individuals over the six months follow-up period (Table 2).

2.3.2. Main analysis

A between-within linear regression model was used to simultaneously investigate the associations of (a) differences in student life challenges (between individuals) and (b) changes in student life challenges between baseline and follow-up (within individuals), with mental health and self-rated health. In this model, time-invariant variables and the person-specific means of the time-varying variables (between-individual estimates) were included in the model. In addition, the time-varying independent variables were transformed into deviations from their person-specific means (within-individual estimates). The regression coefficient of the independent time-varying variables (mental health and

Table 1

Baseline sociodemographics characteristics of 568 university students and cross-sectional associations of sociodemographics characteristics with mental health and self-rated health at baseline.

	Baseline M (SD) N (%)	Mental health ¹ b (SE) [#]	Self-rated health ¹ b (SE) [#]
Age (18-52)	23.2 (4.0)	0.5 (0.2)*	0.1 (0.2)
Gender ²			
- Females	447 (78.7)	-5.2 (1.9)*	-0.4 (2.1)
- Males	112 (19.7)	ref.	ref.
- Non-binary	6 (1.1)	-2.7 (7.6)	-17.3 (6.8)*
Living/studying location			
- Studying in hometown	102 (18.0)	ref.	ref.
- Commuting for studying	314 (55.3)	-2.3 (2.1)	-5.3 (2.3)*
- Moved for studying	152 (26.8)	-1.6 (2.3)	-5.7 (2.5)*
Educational programme			
- Bachelor's	308 (54.2)	ref.	ref.
- Master's	75 (13.2)	3.3 (2.4)	2.1 (2.6)
- Combined	185 (32.6)	-0.3 (1.7)	1.1 (1.9)
Academic progress			
- On track	137 (24.1)	ref.	ref.
- Slightly late	216 (38.0)	-9.3 (2.0)*	-8.0 (2.2)*
- Delay	215 (37.9)	-16.3 (2.2)*	-14.1 (2.4)*

Adjusted for age, gender, living/studying location, educational programme and academic progress.

* P value <0.05.

¹ Higher score means better health.

² Individuals who did not declare the gender (n=3, 0.5%) were not included in the analysis.

Table 2

Variation in mental health, self-rated health, and student life challenges between baseline and six months follow-up between individuals and within individuals among 568 university students.

	Score		Variance	
	Baseline M (SD)	Follow-up M (SD)	Between individuals %	Within individuals %
University students' health ¹				
Mental health (0-100) ³	46.9 (19.1)	50.7 (18.3)	81.6	18.4
Self-rated health (0-100) ³	63.1 (20.5)	65.7 (19.7)	80.9	19.1
Student life challenges ²				
Faculty shortcomings (1-4) ³	2.5 (0.4)	2.5 (0.4)	83.0	17.0
Worries about future (1-4) ³	2.6 (0.8)	2.6 (0.8)	82.2	17.8
Unsupportive climate (1-4) ³	2.1 (0.6)	2.0 (0.6)	85.1	14.9
High workload (1-4) ³	2.9 (0.7)	2.8 (0.7)	83.6	16.4
Low commitment (1-4) ³	1.7 (0.7)	1.7 (0.8)	84.6	15.4
Financial concerns (1-4) ³	2.6 (0.9)	2.5 (0.9)	86.0	14.0

¹ A higher score means a better health

² A higher score means a higher level of stress

³ Range

self-rated health) was decomposed into (i) a between-individuals regression coefficient (β_{bx_i}) representing how the averaged values across all person-observations of individuals are related to the outcome, and (ii) a within individual regression coefficient $\beta_{w(x_{it} - x_i)}$ representing how the variation in the exposure around the individual's mean level of the exposure across all person-observations is related to the outcome (Firebaugh et al., 2013).

$$y_{it} = \beta_w(x_{it} - \bar{x}_i) + \beta_b\bar{x}_i + \gamma Z_{it} + \varepsilon_{it}$$

with Z_{it} and ε_{it} representing respectively the sociodemographic characteristics (age, gender, housing-living situation, educational program, and academic progress) of the individual i at time t , and the error term of the equation. The analyses were performed for each student life challenge separately (Table 3).

2.3.3. Supplementary analyses

To explore selective loss to follow-up, a binary logistic regression analysis was used to investigate the association between sociodemographic characteristics, student life challenges, university students' health and dropout [Supplementary file, Table A]. Descriptive statistics were used to investigate the response to the specific statements to assess student life challenges [Supplementary file, Table B]. The correlations between student life challenges were estimated using Spearman's correlation coefficients to assess multi-collinearity [in the text]. The bivariate correlation between mental health and self-rated health was investigated to assess the strength of the association between the two health measures [in the text].

A sensitivity analysis was performed to investigate whether gender modified associations between exposure to student life challenges (between individuals) and changes in these challenges (within individuals) and mental health and self-rated health [in the text].

All analyses were performed using SPSS version 23.0.

3. Results

The majority of the 568 respondents were female (78.7%), commuting for studying (55.3%), and enrolled in a bachelor's programme (54.2%). Most participants studied medicine (17.6%), followed by literature and languages (14.8%), economics (8.1%), and psychology (7.9%). At baseline, female gender (b: -5.2; SE: 1.9) was associated with poorer mental health, but not with poorer self-rated health. Students commuting (b: -5.3; SE: 2.3) and those who moved for studying (b: -5.7; SE: 2.5) reported poorer self-rated health compared to students studying in their hometown. Respondents slightly late or delayed in their studies reported poorer health compared to those on track, with b's up to -16.3 (SE: 2.2) for mental health and -14.1 (SE: 2.4) for self-rated health (Table 1).

The contribution of the between-individuals variance in mental health (81.6%), self-rated health (80.9%), and in student life challenges (ranging from 82.2% to 86.0%) was substantially larger than the contribution of the variance within individuals. Concerning the student life challenges, worries about future competence (17.8%) and faculty shortcomings (17.0%) were the student life challenges with the highest percentage of the variance explained by changes within individuals. The variance in other student life challenges within individuals ranged from

14.0% (financial concerns) to 16.4% (workload) (Table 2).

3.1. Student life challenges and health: differences between students

A higher exposure to student life challenges was associated with poorer mental health and self-rated health. A one point increase in student life challenges was associated with a 5.3 (financial concerns) to 10.3 (faculty shortcomings) points lower score in mental health. For self-rated health, a one point increase in student life challenges was associated with a 3.1 (financial concerns) to 9.6 (faculty shortcomings) points lower score for self-rated health.

3.2. Student life challenges and health: changes within students

An increase in exposure to student life challenges was associated with a deterioration in university students' health. A one point increase in student life challenges was associated with a deterioration in mental health ranging from 2.7 (financial concerns) up to 5.9 (workload) points. A one point change in exposure to student life challenges was associated with a 3.5 (worries about future competence) to 5.7 (faculty shortcomings) points deterioration in self-rated health. Only a change in exposure to financial concerns and unsupportive climate was not statistically significantly associated with poorer self-rated health.

Participants included in this longitudinal study in general did not differ in sociodemographic characteristics, student life challenges, mental health and self-rated health from those who only filled out the baseline questionnaire and were lost to follow-up [Supplementary file, Table A]. Only those persons with more worries about the future were 1.14 (95% CI: 1.00-1.29) times more likely to drop-out the study.

Table B (Supplementary file) shows the extent to which students reported to be exposed to specific life challenges. The imbalance between passive learning of facts and active seeking of knowledge and time for reflection (87.0%), worries about acquiring/mastering the knowledge needed for the future profession (76.8%), lack in study-life balance (76.6%) and a too high pace of study (74.6%) were the most prevalent student life challenges [Supplementary file, Table B].

No effect modification by gender was found in associations of student life challenges with mental health and self-rated health.

4. Discussion

Students with higher exposure to student life challenges reported poorer mental health and self-rated health. The within-individuals analysis showed that a student reporting an increased exposure to student life challenges is likely to report deteriorated mental health and self-rated health. The student life challenges with the strongest associations with poorer mental health and self-rated health were faculty shortcomings, unsupportive climate and high workload. Overall, this

Table 3

Between-within model estimates of associations of difference in student life challenges with differences in mental health and self-rated health (between-individuals associations) and of associations of changes in stressors and changes in mental health and self-rated health (within-individuals associations) among 568 Italian university students.

	Mental health ¹		Self-rated health ¹	
	Between individuals B (SE) [#]	Within individuals B (SE) [#]	Between individuals B (SE) [#]	Within individuals B (SE) [#]
Faculty shortcomings ²	-10.3 (1.2)*	-5.5 (2.3)*	-9.6 (1.3)*	-5.7 (2.5)*
Worries about future ²	-5.8 (0.8)*	-4.9 (1.6)*	-5.1 (0.9)*	-3.5 (1.7)*
Unsupportive climate ²	-9.3 (1.1)*	-5.6 (2.2)*	-7.4 (1.1)*	-4.7 (2.4)
High workload ²	-9.1 (0.8)*	-5.9 (1.7)*	-6.6 (0.9)*	-4.6 (1.9)*
Low commitment ²	-7.1 (0.8)*	-3.4 (1.8)	-7.0 (0.8)*	-3.8 (1.9)*
Financial concerns ²	-5.3 (0.7)*	-2.7 (1.5)*	-3.1 (0.7)*	1.2 (1.7)

[#] Adjusted for age, gender, living/studying location, educational programme and academic progress.

* P value <0.05.

¹ A higher score means a better health.

² A higher score means a higher level of stress.

study suggests that decreasing the exposure to student life challenges may be beneficial to improve university students' health.

4.1. University students' health: looking between and within students

Most of the variance in student life challenge and health was related to differences between individuals rather than to changes over time at individual level. Differences between individuals may depend on both individual characteristics (e.g. coping strategies, financial situation) and environmental factors (e.g. discipline of study). In total, 18% of the variance in mental health was attributable to changes within-individuals: mental health does not only differ across students, but also changes within them.

The between-individuals analysis showed that higher exposure to student life challenges is associated with students' mental health and self-rated health. This is in line with findings from previous studies (Dahlin et al., 2005). Among the investigated student life challenges, faculty shortcomings, unsupportive climate, high workload and low commitment had the strongest associations with poorer mental health and self-rated health. This suggests that insight into the exposure to student life challenge may help to identify groups or individuals at higher risk of poorer mental health and self-rated health.

The within-individuals analysis shows that, independently from all time-invariant differences between individuals, an increase in exposure to student life challenges is associated with a decrease in health. This suggests that, a decrease in exposure to student life challenges may improve health among university students. To our knowledge, no previous studies investigated the association between changes in exposure to student life challenges and students' health. Our results suggest that student life challenges may be targets for interventions aimed at preventing or reducing health problems.

4.2. Addressing student life challenges

The stressful experience of life challenges for a student may be decreased by tackling the objective component of the challenge and/or by limiting the subjective experience of stress due to the student life challenges. Decreasing the objective component of student life challenges is recommended, but increasing students' resources to respond to the challenge (e.g. copying strategies) is also suggested to improve students' health. Completely removing the objective component is not feasible, given the complexity of reality and the wide range of life challenges every student faces. Moreover, while high exposure to stress increases the likelihood of experiencing mental disorders, a moderate exposure to stress was found to increase resilience in individuals by leading them to improve their strategies of coping (Crane et al., 2019).

In our study, we investigated six student life challenges. The strongest associations were found for faculty shortcomings, unsupportive climate and high workload. These dimensions of student life challenges were based on specific statements, which provide possible targets to address to improve students' health. Faculty shortcomings for example concerned too much focus on passive learning of facts and too little on active seeking of knowledge and time for reflection, a lack of opportunities to influence the curriculum, and insufficient preparing for the future profession. These faculty shortcoming may be addressed by increasing the active role of students into their education at two levels: teaching methods and study control.

Universities could adopt and combine innovative teaching methods such as active learning, flipped classroom, problem-solving sections, teaching by doing, student-centered learning, and critical thinking education. These approaches require students to actively take part into the education process by discussing, searching for and re-elaborate information, and solve problems (Michael, 2006). These innovative methods were found to increase engagement and motivation in students (Gill-Lacruz et al., 2019; McEvoy, 2017), with increasing or stable students' performance (Crisafio and Cho, 2020; Freeman et al., 2014; Singh et al.,

2019; Subramanian et al., 2012). Moreover, some studies associated the adoption of these forms of education with improved professional self-esteem and increased problem-solving skills, which were associated with lower levels of perceived stress in students (Kanbay and Okanli, 2017; Singh et al., 2019). Improvement in critical thinking, problem-solving skills and in the ability to manage stress are possible outcomes of the introduction of these innovative teaching methods, and are considered among the 10 most important skills for future jobs (World Economic Forum, n.d.). Increasing these skills may result in students who are healthier and sustainable employable.

Faculties may increase the influence students have on their studies to promote their health. Previous studies found low study control to be associated with poorer health among university students (Cotton et al., 2002; Tuomi et al., 2013). Allowing students to personalize their curriculum could lead them to indulge more personal inclinations and interests and to select activities close to the desired future profession and have better insights into it. Consequently, students could be enhanced to make better and more informed choices in career. This could be beneficial for students' health, considering that in our sample more than half of the respondents felt that the training did not prepare them well for their future profession. Activities tailored to students' career preferences may lead them towards the acquisition of specific knowledge and skills which may decrease their worries about their future, increase their sense of competence and improve their employability in the field of interest. In addition to faculty shortcomings, an unsupportive climate - with a competitive attitude among students as most prevalent mentioned challenge - was also associated with poorer health. The introduction of the innovative teaching methods could be beneficial also at this level by increasing collaboration among peers (Njie-Carr et al., 2017). In our sample, almost one in three students did not feel respected by teachers. Previous research showed that disrespectful behaviors (e.g. teaching by humiliating) from teachers and staff are often reported by students and are associated with poorer health and decreased belongingness (Barrett and Scott, 2018; Levett-Jones et al., 2009). Instead, being respected by university staff increases the reward perceived by students, which can balance the high academic effort, limiting the adverse effect of a high workload on students health (Porru et al., 2021; Wege et al., 2017). Tackling disrespectful behaviors and promoting a good relation among students and between students and university staff may decrease faculty shortcomings, increase students' engagement, and empower students to handle higher workload resulting in better university students' health and performance (Slavin and Smith, 2019).

A high workload was also associated with mental health and self-rated health. Life-study balance was one of the aspects contributing to the workload. Three in four students reported that their study controlled their life leaving no time for other activities. A previous study identified time for loved ones (e.g. family, friends), intellectual and creative health (e.g. play an instrument, photography), relaxation (e.g. days off) and pleasure and outdoor activities (e.g. sex, sport events), hobbies (e.g. reading, watching tv), and engaging in physical activity as self-care activities adopted by students (Ayala et al., 2017). A lack in study-life balance may result in a decreased time devoted to these self-care activities which could explain the association between poor study-life balance and poorer students' health (Ball and Bax, 2002; Portoghese et al., 2020; Stallman and Hurst, 2016). Universities may improve students' health by promoting a lifestyle in which students dedicate time to their own health, and dedicating resources to make this easier and affordable (Vankim and Nelson, 2013). On their side, students could actively try to include self-care activities as part of their routine, according to their preferences and needs.

4.3. Sociodemographics and students' health

In line with the literature, female and non-binary students reported poorer mental health (Anderssen et al., 2020; Dunbar et al., 2017). Although the prevalence of mental health problems is higher among

female students, no gender differences were found in the associations between exposure to student life challenges and poorer mental health. In this study, three in four students reported to be delayed in their studies, and this was strongly associated with poorer health. Previous studies found an association of mental health with academic outcomes (e.g. grades, dropout) (Andrews and Wilding, 2004; Auerbach et al., 2016; Bruffaerts et al., 2018; Hjorth et al., 2016; Hysenbegasi et al., 2005). Reversed causality is likely to play a role, with individuals experiencing poor mental health more likely to perform poorly, and students performing poorly more likely to experience poorer health. However, given that in 2019 in Italy only 55.7% of graduated students obtained their diploma on time (AlmaLaurea, 2020) and the COVID-19 pandemic in 2020 may have increased the amount of students with delay in the study plan, policy-makers and universities may consider to pay attention to the study progress of students and its association with mental health.

5. Strengths and weaknesses

Several strengths and weaknesses of this study were identified. The longitudinal design is a strength. The choice of six months of follow up has implications for the interpretation of the current study. Academic life is a relatively short period of life which may last only few years and is characterized by the alternation and combination of lectures, internships and exams terms, with differences across faculties and year of enrolment. Consequently, the exposure to student life challenges may change during the academic year. A relatively short follow up allowed us to capture the dynamic situation across the academic year, rather than to compare the same moment in two different years. The choice of two concepts of health, only moderately correlated, using questionnaires with proven validity and broad use is a strength of this study (DeSalvo et al., 2005). The use of an Italian version of the HESI questionnaire is a strength because of its focus on university-related life challenges and other life challenges. The lack of evidence of its psychometric properties in the Italian population may be a weakness. The use of a between-within model is a strength. Most of the previous studies have investigated only differences between individuals, while the between-within model investigates also the changes in exposure to student life challenges within individuals during a study year and its association with health.

The use of a convenient sample recruited online has strengths and weaknesses. The online recruitment and data collection may have influenced participation. The possibility to fill out the questionnaire online at any time and in any place offered more privacy to respondents, decreasing reporting bias for sensitive topics (Gnambs and Kaspar, 2017). Students experiencing problems with study delay, who were found to be experiencing poorer health in this study, may be more likely to respond to this questionnaire and to be over represented in this study. However, the focus of this study is on associations rather than on the prevalence and the within-individual analysis is by definition less influenced by selection bias. The unicentric design of the study, together with the low response and high loss to follow-up, is a weakness which may reduce the generalizability of our results. However, no indications for selective drop-out were found.

6. Conclusion

Our findings show that a higher exposure to student life challenges is associated with poorer mental health and self-rated health among university students. Interventions addressing student life challenges may contribute to promote mental health and self-rated health among university students. Universities may address student life challenges acting on teaching methods and academic environment, and motivating and enhancing students to actively take care of their own health.

Availability of the data

Raw data pertaining to analyses performed in this study are available from the authors upon reasonable request. Proposals for research based on these data are welcome and can be sent to unicares@erasmusmc.nl.

Funding

The authors did not receive any funding for this study.

CRediT authorship contribution statement

Fabio Porru: Conceptualization, Data curation, Formal analysis, Project administration, Writing – original draft. **Merel Schuring:** Conceptualization, Methodology, Supervision, Writing – review & editing. **Ute Bültmann:** Writing – review & editing. **Igor Portoghese:** Writing – review & editing. **Alex Burdorf:** Conceptualization, Writing – review & editing. **Suzan J.W. Robroek:** Conceptualization, Supervision, Writing – review & editing.

Declarations of Competing Interest

None.

Acknowledgment

We would like to thank Monica Palmisano for her essential contribution to the data collection.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.jad.2021.09.057](https://doi.org/10.1016/j.jad.2021.09.057).

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