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Sex-specific associations between sleep and mental health in university students: a large cross-sectional study

Ilaria Montagni, PhD[a] (iD), Sarah Qchiqach, MSc[a], Edwige Pereira, MSc[a], Phillip J. Tully, PhD[b] (iD), and Christophe Tzourio, PhD, MD[a] (iD)

[a]Bordeaux Population Health Research Center, Team HEALTHY, UMR 1219, Univ. Bordeaux, Inserm, Bordeaux, France; [b]Centre for Men's Health, University of Adelaide, Adelaide, Australia

ABSTRACT

Objective: To examine the associations between sleep problems and mental health dimensions in university students, and the effect of sex on these associations. **Participants**: Self-reported survey data from 3,483 students aged 18–30 years was drawn from a larger web-based study (i-Share) conducted in France in the years 2013–2017. **Methods:** We performed logistic regression analyses stratified by sex using insufficient sleep duration, poor sleep quality, difficulty initiating sleep and excessive daytime sleepiness, in relation with stress, self-esteem, depression and anxiety. **Results:** All sleep problems were strongly associated with all mental health dimensions, particularly anxiety, in female students. Sleep and mental health problems were also associated in male students, with the exception of low self-esteem, but odds ratios were lower than for female students. **Conclusions:** Present findings warrant attention to propose early interventions targeting sleep and mental health in the university setting taking sex into account.

Sleep and mental health problems are common in university students.[1] This population is particularly exposed to important stressors, such as academic competitiveness, new responsibilities and loneliness, which contribute to both sleep and mental health disturbances, with possible negative consequences ranging from academic dropout to chronic diseases later in life.[2,3]

The recommended amount of sleep is between 7 and 9 hours for young adults aged 18–25 years.[4] University students often report insufficient sleep duration,[5] poor or very poor sleep quality,[6] and excessive daytime sleepiness.[7] Causes of disturbed sleep in this specific population are varied and include, for instance, class scheduling with classes starting early in the morning, all-night study sessions, and consumption of caffeine and other stimulating substances.[8,9]

On the other hand, there is also a well-known high prevalence of mental health problems in university students, including high levels of perceived stress,[10] low self-esteem[11] depressive symptoms[12] and anxiety.[13]

Previous studies have established that sleep problems are associated with poor mental health at all ages.[14] Sleep problems are even among the symptoms and the diagnostic criteria of some psychiatric disorders, but the relationship between mental health and sleep is complex and includes bidirectional causation.[15] Additionally, limited research has focused on university students, with very few data concerning European students.[16] Furthermore, while research shows that sex is correlated with the prevalence of certain mental disorders including depression and anxiety,[17] findings concerning sex differences in sleep problems are inconsistent, especially among young adults.[18,19] Some biological maturational processes may contribute to sex differences in sleep, but other factors like response to stress and psychological well-being can be involved. These research gaps need to be addressed in order to identify the underlying nature of sex differences concerning sleep patterns and associated mental health factors. Understanding the significance of sex in sleep and mental health problems would have important applications for interventions relating to female and male students in a critical transition period of life with specific health and developmental needs.

The aim of this study was to report the associations of sleep problems with different dimensions of mental health (stress, self-esteem, depression, and anxiety) in a large sample of female and male university students from different years and fields of study. Sex differences were examined in details, under the hypothesis that female students would show stronger associations between sleep problems and poorer mental health.

Methods

Study design and population

Participants were enrolled in the Internet-based Students Health Research Enterprise project (i-Share), a prospective

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population-based cohort study of students of French speaking universities. The i-Share project was initiated by the Universities of Bordeaux and Versailles Saint-Quentin (France), where active recruitment started in February 2013. The project was further extended to all universities and higher education institutes in France on a voluntary basis.

To be eligible to participate, a student had to be at least 18 years of age and be able to read and understand French. Students were informed about the purpose and aims of the i-Share project by flyers, information stands at university registrations, during lectures, and via social media and newsletters. The i-Share project consists of a web-based baseline questionnaire asking information on the participant's health status, personal and family medical histories, socio-demographic characteristics, and lifestyle habits, including sleep. Within three months after completion of the baseline questionnaire, a supplementary web-based questionnaire concerning mental health is addressed to students to explore more precise information on psychological factors including stress, self-esteem, depressive symptoms, and anxiety. Like the baseline questionnaire, the mental health questionnaire is completed on a voluntary basis. For this study, we used data available as of 7th February 2017.

The i-Share project was carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki). Every student signed an online informed consent form before completion of the baseline questionnaire.

Measures

Sleep status

Sleep status was measured by three items from the Pittsburgh Sleep Quality Index[20] and a single item from an epidemiologic study of self-reported sleep problems among Japanese adolescents.[21] The four items we explored were as follows:

1. Insufficient sleep duration (categorized as never/several times per year/several times per month/several times per week/always).
2. Poor sleep quality during the 3 previous months preceding the survey (categorized as good/somewhat good/ neither good nor bad/somewhat bad/bad).
3. Difficulty initiating sleep during the 3 previous months preceding the survey (categorized as never or less than once a month/less than once a week/from 1 to 2 days per week/from 3 to 5 days per week/every day or almost every day).
4. Excessive daytime sleepiness during the 3 previous months preceding the survey (categorized as never or less than once a month/less than once a week/from 1 to 2 days per week/from 3 to 5 days per week/every day or almost every day).

We used the following thresholds: for question 1, if the subject gave an answer of several times per week or always, he or she was considered to have insufficient sleep duration.

For question 2, if the subject gave an answer of somewhat bad or bad, he or she was considered to have poor sleep quality. For questions 3 and 4, if the subject gave an answer from 3 to 5 days per week or every day or almost every day, he or she was considered to have difficulty initiating sleep or excessive daytime sleepiness. Cutoff points and categorizations of all four sleep problems measures were in accordance with previous studies employing the same items.[21,22]

Stress

Stress was assessed using the Perceived Stress Scale-4 (PSS-4),[23] which is a 4-item measure of the degree of stress experienced in the month preceding the survey. Using a 5-point Likert scale ranging from 0 (never) to 4 (very often), participants indicated the extent to which they experienced feelings such as "Felt that you were unable to control the important things in your life" and "Felt difficulties were piling up so high that you could not overcome them." The four items of the PSS-4 were considered as a global score ranging from 0 to 16, with higher scores correlated to higher stress. We treated this variable as a continuous one, by arbitrarily opting for this solution since a consensus threshold for the PSS-4 does not exist in the literature, as reported by a review of the psychometric evidence of the PSS.[24] According to this review, the Cronbach's alpha of the PSS-4 ranged from <.60 to 0.82.

Self-esteem

Self-esteem was assessed using the Rosenberg's Self-Esteem Scale (RSE),[25] which is a 10-item, 4-point Likert scale considered to be a reliable and valid self-report scale used to assess feeling of self-worth.[26] The range of possible scores is 10–40 corresponding to the following categories: very low (10–24), low (25–30), medium (31–34), high (35–40), and very high (≥40) self-esteem. In college populations, Cronbach's alpha was 0.89.[27]

Depression

Depression was assessed using the Patient Heath Questionnaire-9 (PHQ-9).[28] Participants reported how frequently they experienced depressive symptoms during the 2 weeks preceding the survey on a scale from 0 to 3 (0 = not at all, 1 = several days, 2 = more than half the days, 3 = nearly every day). The nine items were summed with scores ranging from 0 to 27. We further isolated the item evaluating the presence of a "trouble falling or staying asleep or sleeping too much" from the other eight items. For the latter, we applied the scoring system proposed by Kroenke and colleagues for the reduced scale called PHQ-8,[29] with summed scores ranging from 0 to 24. In Kroenke and colleagues' studies, Cronbach's alpha was .89 for the PHQ-9 and .80 for the PHQ-8. As suggested by Garlow and colleagues[30] working on college students' depression, we used the following categories: minimal (1–4), mild (5–9), moderate (10–14), moderately severe (15–19), and severe (>19) levels of depressive symptoms. For the PHQ-9, we grouped

minimal and mild categories versus the other three categories (moderate, moderately severe, and severe). For the PHQ-8, the cutoff score was 10.

A descriptive analysis was performed between the single item on sleep trouble of the PHQ-9 and the sleep status item on the "difficulty initiating sleep during the 3 previous months preceding the survey". The rationale was to assess the relationship between sleep-specific depressive symptoms with sleep status, and thereby reduce confounding in the main analysis of PHQ-8 items with sleep status. Spearman correlation was used to assess the correlation between the PHQ-9 item on sleep trouble and the item on difficulty initiating sleep.

Anxiety

Anxiety was assessed using the State-Trait Anxiety Inventory Form Y (STAI-Y)[31] a 20-item scale measuring how participants felt at the current moment ("state") and in general ("trait"). Participants choose responses ranging from 1 to 4 (1 = almost never, 2 = sometimes, 3 = often, 4 = almost always) with summed scores ranging from 20 to 80. We applied the scoring system proposed by Bruchon-Schweitzer and Paulhan[32] and we used the following categories: very low (<35), low (36–45), medium (46–55), high (56–65), and very high (>65) anxiety. In this study, Cronbach's alpha was 0.89.

Socio-demographic characteristics

The socio-demographic characteristics were: sex (Female/ Male), age (18–30 years old), field of study (Literature, Languages and Social Sciences/Health Studies/Scientific Disciplines/Law and Economy/Other/Missing indicator variable) and year of study (1st/2nd/3rd/>3rd/Missing indicator variable). Concerning the field of study, Health Studies comprised disciplines like Medicine, Pharmacy, Odontology and Nursing; Scientific Disciplines comprised, among others, Chemistry, Physics, Informatics, Engineering, and Mathematics; and Other disciplines comprised all fields of study which could not be categorized in proposed fields.

Statistics

SAS version 9.3 (SAS Institute Inc, Cary, NC, USA) for Windows was used for all analyses. Sleep status, mental health status and socio-demographic characteristics were examined through univariate logistic regression models for the total sample, and for female and male students. Missing values were kept in the analyses as a separate category. The level of significance was set at $p < .05$.

To examine the association of the four mental health dimensions with the four sleep problems, we performed univariate logistic regression analyses. We also tested the interactions among the four mental health dimensions finding no significant interaction. However, when testing sex interactions in the associations between the four mental health dimensions and the four sleep problems, we found that sex always interacted with at least one mental health dimension

in each univariate logistic regression analysis (p values ranging from .0016 for stress to .353 for depression). In order to assess sex differences in the associations between each sleep problem and each mental health dimension, we performed separate univariate models stratified by sex, for a total of 32 models. Analyses were adjusted forcing the academic characteristics of field and year of study. The odds ratio (ORs) and 95% confidence interval (CI) were presented to show any associations.

Results

Sample characteristics

A total of 4,305 students having completed the baseline questionnaire were sent an e-mail invitation to answer an optional supplementary mental health questionnaire. We excluded students who did not complete the mental health questionnaire ($n = 505$) and who were <18 or >30 years old ($n = 47$). Thus, the final sample was 3,483. The flow chart of the participating students is described in Figure 1.

The average age of study participants was 21.1 years (SD = 2.4, range= 18–30 years). Students were mostly females ($n = 2,717$; 78.0%), freshmen (39.9%), and attending Health Studies ($n = 1,286$; 36.9%).

Insufficient sleep duration was found among 50.7% of students (51.7% of female students, 47.0% of male students); poor sleep quality among 21.8% (22.9% of female students, 18.1% of male students); difficulty initiating sleep among 22.4% (24.2% of female students, 16.0% of male student); and excessive daytime sleepiness among 21.2% (23.2% of female students, 14.1% of male students). Univariate logistic regressions revealed that sex was associated with all four sleep problems: insufficient sleep duration ($p = .0204$), poor sleep quality ($p = .0054$), difficulty initiating sleep ($p < .0001$), and excessive daytime sleepiness ($p < .0001$).

Participants' socio-demographic characteristics, mental status and sleep status are synthetized in Table 1. Data about PHQ-9 are available as an e-Supplement (Table A.1).

Association between sleep and mental health patterns

We performed logistic regression analyses to estimate the association between four sleep problems (insufficient sleep duration, poor sleep quality, difficulty initiating sleep, and excessive daytime sleepiness) and four mental health dimensions (stress, self-esteem, depressive symptoms, and anxiety). Analyses were stratified by sex to verify whether the associations between each sleep problem and each mental health dimension were different in female and male students (Tables 2 and 3, respectively). Data about PHQ-9 are available as an e-Supplement (Tables A.2 and A.3 respectively).

All four sleep problems were significantly associated with all four mental health dimensions in female students (Table 2). For them, anxiety was the strongest predictor of poor sleep quality with OR of 3.42 (95% CI: 2.75–4.26), and depressive symptoms of excessive daytime sleepiness with OR of 3.05 (95% CI: 2.50–3.73). Apart for sleep quality, on
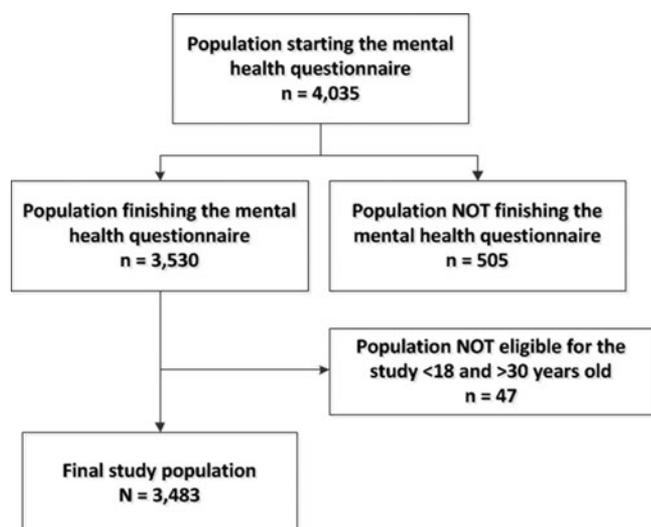
Figure 1. Flowchart of students participating in the study.

Table 1. Description of the socio-demographic characteristics, the mental health status and the sleep status of the sample ($N = 3,483$) stratified by sex.

| | Sex | | | | | |
| | Male | | Female | | Total | |
Continuous variables	M	SD	M	SD	M	SD
Age	21.1	2.4	20.6	2.2	20.7	2.2
Self-perceived stress (PSS-4)	5.9	3.1	7.2	3.2	6.9	3.2
Categorical variables	n	%	n	%	n	%
Field of study						
Literature, Languages and Social Sciences	94	12.3	555	20.4	649	18.6
Health Studies	315	41.1	971	35.7	1286	36.9
Scientific disciplines	103	13.4	319	11.7	422	12.1
Law and Economy	58	7.6	212	7.8	270	7.8
Missing	135	17.6	427	15.7	562	16.1
Other	61	8.0	233	8.6	294	8.4
Year of study						
1st year	250	32.6	1137	41.8	1387	39.8
2nd year	179	23.4	522	19.2	701	20.1
3rd year	128	16.7	403	14.8	531	15.2
>3rd year	191	24.9	574	21.1	765	22.0
Other	18	2.3	81	3.0	99	2.8
Self-esteem (RSE)						
Very high or high	274	35.8	479	17.6	753	21.6
Medium, low or very low	492	64.2	2238	82.4	2730	78.4
Depressive symptoms (PHQ-8)						
Low or mild	673	87.9	2122	78.1	2795	80.2
Moderate, moderately severe or severe	93	12.1	595	21.9	688	19.8
Anxiety (STAI-Y)						
Very low or low	453	59.1	1068	39.3	1521	43.7
Medium, high or very high	313	40.9	1649	60.7	1962	56.3
Insufficient sleep duration						
Never	27	3.5	50	1.8	77	2.2
Several times per year	114	14.9	281	10.3	395	11.3
Several times per month	265	34.6	980	36.1	1245	35.7
Several times per week	268	35.0	1046	38.5	1314	37.7
Always	92	12.0	360	13.2	452	13.0
Poor sleep quality	162	21.1	444	16.3	606	17.4
Good						
Somewhat good	305	39.8	975	35.9	1280	36.7
Neither good nor bad	160	20.9	677	24.9	837	24.0
Somewhat bad	121	15.8	527	19.4	648	18.6
Bad	18	2.3	94	3.5	112	3.2
Difficulty initiating sleep						
Never or less than once a month	301	39.3	770	28.3	1071	30.7
Less than once a week	191	24.9	646	23.8	837	24.0
From 1 to 2 days per week	151	19.7	643	23.7	794	22.8
From 3 to 5 days per week	79	10.3	378	13.9	457	13.1
Every day or almost every day	44	5.7	280	10.3	324	9.3
Excessive daytime sleepiness						
Never or less than once a month	290	37.9	772	28.4	1062	30.5
Less than once a week	201	26.2	663	24.4	864	24.8
From 1 to 2 days per week	167	21.8	651	24.0	818	23.5
From 3 to 5 days per week	75	9.8	375	13.8	450	12.9
Every day or almost every day	33	4.3	256	9.4	289	8.3
Total	766	100.0	2717	100.0	3483	100.0

the whole, the highest ORs were reported for depressive symptomatology. Concerning male students (Table 3), all four mental health dimensions were found to be significantly associated with the presence of all sleep problems, with the sole exception of self-esteem which was significantly associated only with poor sleep quality. In male students, depressive symptoms were the strongest predictor of poor sleep quality with an OR of 2.48 (95% CI: 1.52–4.04). The second strongest predictor of poor sleep quality was anxiety, with an OR of 2.40 (95% CI: 1.64–3.52). Concerning the isolated PHQ-9 item on sleep trouble, it was significantly associated with difficulty initiating sleep ($p < .0001$, Spearman correlation of 0.38).

Comment

This study found that sleep problems were frequent in university students with at least one student out of five affected by either difficulty initiating sleep (22.4%), or poor sleep quality (21.8%), or excessive daytime sleepiness (21.2%). These estimates were slightly lower than those from a previous study on 1,125 students from a United States university: 32% of participants had reported an inability to fall asleep within 30 minutes at least once a week, 38.2% poor sleep time, and 25% daytime sleepiness.[8] These discrepancies may be explained by the different questions used to determine sleep problems, as well as the differences in settings. Besides, insufficient sleep duration was reported more than twice the other three sleep problems (50.7%) with a higher rate than previous research (30.2%) concerning 1,414 students of one Korean university.[5] Female students reported a significantly higher prevalence of all four sleep problems under study, which is in line with previous research.[16] Sex differences in self-reporting sleep problems may be explained by some biological maturational processes, but also by psychosocial factors and general mental health status. For this, we examined relations between sleep and mental health problems in the total sample and found that the strongest associations were observed between all mental health dimensions and poor

sleep quality. These findings were in accordance with studies linking bad sleep quality with unfavorable psychosocial outcomes in other university students' populations.[33,34] Specifically, depressive symptoms and anxiety were the strongest predictors of all four sleep problems, as observed in previous research.[35] To the same extent, decreased levels of self-esteem were associated with decreased sleep quality. On the other hand, stress was the lowest risk factor for all sleep problems in both sexes. This might be explained by the fact that stress is not harmful if it is short-term, for example, limited to exam periods, thus not chronically altering sleep hygiene. In contrast, depressive symptoms, anxiety and low self-esteem are long-term conditions which can

Table 2. Association between sleep and mental health patterns* in female students (n = 2,717).

Measures	Insufficient sleep duration			Poor sleep quality			Difficulty initiating sleep			Excessive daytime sleepiness		
	OR	CI	p value	OR	CI	p value	OR	CI	p value	OR	CI	p value
Self-perceived stress (for an increase of 1 point in the score) (PSS-4)	1.16	[1.13–1.19]	<.0001	1.27	[1.23–1.31]	<.0001	1.22	[1.18–1.25]	<.0001	1.22	[1.18–1.26]	<.0001
Self-esteem (RSE)			<.0001			<.0001			<.0001			<.0001
Very high or high	1	–		1	–		1	–		1	–	
Medium, low or very low	1.57	[1.28–1.92]		2.12	[1.60–2.81]		2.11	[1.60–2.78]		1.93	[1.47–2.54]	
Depressive symptoms (PHQ-8)			<.0001			<.0001			<.0001			<.0001
Low or mild	1	–		1	–		1	–		1	–	
Moderate, moderately severe or severe	3.00	[2.45–3.65]		3.02	[2.47–3.68]		2.71	[2.22–3.30]		3.05	[2.50–3.73]	
Anxiety (STAI-Y)			<.0001			<.0001			<.0001			<.0001
Very low or low	1	–		1	–		1	–		1	–	
Medium, high or very high	2.16	[1.84–2.53]		3.42	[2.75–4.26]		2.89	[2.36–3.56]		2.80	[2.27–3.45]	

*Adjusted on field and year of study.

Table 3. Association between sleep and mental health patterns* in male students (n = 766).

Measures	Insufficient sleep duration			Poor sleep quality			Difficulty initiating sleep			Excessive daytime sleepiness		
	OR	CI	p value	OR	CI	p value	OR	CI	p value	OR	CI	p value
Self-perceived stress (for an increase of 1 point in the score) (PSS-4)	1.14	[1.08–1.19]	<.0001	1.16	[1.10–1.24]	<.0001	1.09	[1.03–1.16]	.0059	1.07	[1.00–1.14]	.0444
Self-esteem (RSE)			.1179			.0295			.1834			.6993
Very high or high	1	–		1	–		1	–		1	–	
Medium, low or very low	1.27	[0.94–1.72]		1.58	[1.05–2.40]		1.34	[0.87–2.04]		1.09	[0.70–1.69]	
Depressive symptoms (HPQ-8)			.0318			.0003			.0053			.0097
Low or mild	1	–		1	–		1	–		1	–	
Moderate, moderately severe or severe	1.63	[1.04–2.54]		2.48	[1.52–4.04]		2.11	[1.25–3.55]		2.07	[1.19–3.59]	
Anxiety (STAI-Y)			<.0001			<.0001			.0468			.0463
Very low or low	1	–		1	–		1	–		1	–	
Medium, high or very high	2.36	[1.75–3.18]		2.40	[1.64–3.52]		1.49	[1.01–2.22]		1.53	[1.01–2.32]	

*Adjusted on field and year of study.
Note. CI = Confidence interval; OR = Odd ratio; PSS-4 = Perceived Stress Scale-4 Item; RSE = Rosenberg's Self-Esteem Scale; PHQ-8 = Patient Heath Questionnaire-8 Item; STAI-Y = State-Trait Anxiety Inventory Form Y.

trigger sleep problems or make existing sleep problems worse in the long run.

When contrasting results per sex, we observed that associations were stronger for female students across all sleep and mental health problems. This was in line with our hypothesis that, since sex differences in reporting mental health problems are well-known, sex differences would be found also in sleep patterns and their associations with mental health problems. In particular, female students reporting from moderate to severe depressive symptoms or from medium to very high anxiety were three times more at risk of having troubled sleep. Our results confirmed then the association between depression and sleep problems in female students expanding upon previous research[36] by providing information specifically on timing of sleep and sleepiness. However, although we found a sex effect in relations between all sleep and mental health problems, associations, excluding self-esteem, were significant also for male students, thus confirming that sleep problems are comorbid with mental health disturbances.[37]

One of the primary strengths of this research was in our large sample composed of 3,483 university students from different years and fields of study. Previous research on the association between sleep and mental health problems in university students has been limited to small samples, ranging from cross-sectional studies of 40 people[38] to cohorts of 1,000 young adults,[34] and mainly coming from medical and health disciplines.[39] A similar study was conducted in 2,831 university students from Germany and Luxembourg[16] but not examining difficulty initiating sleeping among sleep problems, nor self-esteem among mental health dimensions. Another added value of this study was, in fact, the inclusion of self-esteem among examined measures. Self-esteem is in fact a basic feature of mental health and a protective factor contributing to positive social behavior.[40] While previous research has mostly examined the relation between sleep problems and depression,[41] stress[42] and anxiety,[35] the direct association of self-esteem with sleep has not been largely explored in university students.[43] So far, existing studies have been conducted mainly in the general population[44] and adolescents,[45] finding that better and longer sleep is associated with a higher self-esteem. Finally, another strength was the inclusion of the PSS-4, the RSE, the PHQ-9, and the STAI-Y as established exposure and outcome measures of participants' mental health. These self-report instruments are used extensively in clinical settings and have sound psychometric proprieties.

Study limitations

The study findings are presented with several limitations. Firstly, our sample was not representative of all French university students as participation was voluntary. Generalizability to all French students and to students from other countries might therefore be limited. However, our study represented the entire panel of available university curricula in France compared to existing research.[6,46] Furthermore, the stratification by sex allowed inferring results notwithstanding the high number of female students (78.0% in the current sample; 58.3% in the University of Bordeaux[47]). Secondly, sleep problems were self-reported and nonobjectively measured. However, compared to laboratory studies, the way sleep is measured is different in most epidemiologic studies and little validation exists for questions on sleep quality and quantity.[48] Thirdly, our analyses were only cross-sectional and did not inform on the direction of the relationship between sleep problems and mental health. The exact mechanisms underlying these associations remain speculative and should be explored in longitudinal studies.

Implications

The high prevalence of sleep problems in university students and their strong associations with mental health may warrant implementation of interventions to promote sleep awareness, hygiene and practices within the university setting. These interventions are expected to be more effective if they are sex-tailored. Identifying and solving sleep problems at an early stage of young adults' life is important to improve their overall health, including mental health. Universities offer enormous potential as settings to promote sleep-health since they can reach many young people who are future-oriented and willing to learn. There is then the need for academic researchers, teaching staff and health professionals working for university students' health, to develop and test a wide array of sleep-promoting interventions (e.g., education classes, online programs, adjustment of class time), thus preventing negative secondary outcomes.

Conclusions

Our study indicated that sleep problems were highly frequent and were associated with several mental health indicators in university students. The associations were slightly stronger in women than in men. These results call for early interventions on sleep and mental health in this special population, especially in female students.

Author contribution

IM, SQ, EP, and CT designed the study. SQ and EP analyzed the data and synthesized results. IM drafted the manuscript, PT contributed to the final writing, and CT supervised the entire study. All authors provided critical feedback and helped shape the research, analysis and manuscript.

Conflict of interests

All authors declare: no support from any organization for the submitted work; no financial relationships with any organizations that might

have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

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Data availability statement

The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials. Raw data are available from the principle investigator of the i-Share study on request.

Ethics approval

The i-Share project was approved by the "Commission Nationale de l'Informatique et des Libertés" (CNIL – National Commission of Informatics and Liberties) [DR-2013-019] and every student signed an online informed consent form before completion of the baseline questionnaire.

ORCID

Ilaria Montagni http://orcid.org/0000-0003-0076-0010
Phillip J. Tully http://orcid.org/0000-0003-2807-1313
Christophe Tzourio http://orcid.org/0000-0002-6517-2984

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