

# Sleep quality among Italian university students: the UnSleep multicenter study

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*Parole chiave: Sonno; studenti universitari; dispositivi elettronici; stili di vita*

## Abstract

**Background.** Scientific evidence demonstrates that poor sleep quality can lead to various health problems. This study aimed to investigate sleep patterns among Italian university students and identify several factors that may contribute to its quality.

**Study design.** Cross-sectional study.

**Methods.** An electronic questionnaire regarding sociodemographic characteristics, lifestyle, and sleep-related habits, including the Pittsburgh Sleep Quality Index (PSQI) questionnaire, was distributed between January 2022 and July 2023 among students belonging to 12 universities located in Northern, Central, and Southern Italy.

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**Results.** On a total of 1,674 questionnaires collected, the participants (mean age  $24.06 \pm 4.56$  years, 71.3% F) reported an average number of hours of nocturnal sleep equal to  $6.89 \pm 1.28$  hours. A total of 927 (54.6%) of respondents showed a poor sleep quality (PSQI >5). Regression analysis showed that better sleep quality is associated with lower age, attending universities in Northern Italy, less time spent on electronic devices during the day, not being used to study at night and not playing videogames before sleep.

**Conclusion.** From a public health perspective, our findings suggest that public health operators should raise the awareness of young adults about the importance of sleep quality for maintaining good health, as well as the impact that certain behaviors can have on sleep.

## Introduction

Sleep is a fundamental physiological process, and the importance of its quality for humans' health and well-being has been widely recognized (1). Although there is still no universally agreed-upon definition, sleep quality is understood as a combination of the individual's subjective satisfaction and certain quantitative components, such as duration, latency of onset, and sleep maintenance (2,3). Poor sleep quality, in the worst cases, can take on pathological characteristics such as insomnia, which is a sleep disorder characterized by repeated difficulties in the initiation, duration, maintenance, or quality of sleep. Numerous studies have demonstrated how poor sleep quality and actual sleep disorders negatively impact both the physical and mental health and the overall quality of life of individuals (4,5). The mutual relationship between sleep and mental health has been extensively researched and documented in various conditions, including post-traumatic stress disorder, and eating disorders, but also experiences on the psychosis spectrum, such as delusions and hallucinations (6). On the other hand, sleep disorders can represent either risk factors or consequences in other pathological conditions, such as cardiovascular and metabolic diseases, anxiety and depression, reduced cognitive functioning, which in turn can negatively affect daytime performances, both socially and professionally, and increase the risk of workplace and traffic accidents (4,7-10). It is evident, therefore, that conditions of severe and chronic poor sleep quality represent a public health issue and, consequently, the assessment of sleep quality is crucial for epidemiological and clinical studies (11). In contrast, complying with the sleep hygiene basics by handling sleep time and daily habits can improve sleep quality and duration (12).

Poor sleep quality, with varying levels of severity, appears to be particularly common in young adults, especially among university students: several studies

conducted in different socio-cultural contexts have reported prevalence rates of poor sleep quality ranging from 50% to 70% (13-19). Some studies indicate that between 20% and 40% of university students sleep fewer than the 7 to 9 hours recommended for their age group, which is worrying considering that insufficient sleep can have negative effects on health such as obesity, hypertension, diabetes, and the development of conditions related with the onset of depression and anxiety symptoms, such as stress and burnout (13-15, 20-22). Additionally, it is known that the restrictions related to COVID-19 had an impact on sleep quality of university students (23): studies performed during that period reported an increase in sleep difficulties associated with high levels of depression, anxiety, and stress (23-25).

Numerous studies on this topic have been performed among students from different countries, including Jordan (26), United States (13), Mongolia (17), Ethiopia (14) and, in the European context, Germany (27) and Italy (28). However, the validity of the evidence coming from these investigations is often limited by the characteristics of the study samples, which are commonly represented by undergraduates enrolled in only one or few universities of each country. Many studies have also tried to identify factors related with sleep quality in university students, and their results appear heterogeneous, maybe due to the different cultural contexts examined (13,18,29,30). Furthermore, it should be considered that the cross-sectional design of these studies cannot allow to ascertain causal relationships between the investigated factors and sleep quality.

The multicenter study on University Students' Sleep (UnSleep) aimed at examining sleep quality in a sample of undergraduates enrolled across the whole Italian territory. Furthermore, possible associations between sleep quality and socio-demographic aspects, lifestyles and sleep-related habits of the Italian undergraduates were also examined.

## Material and methods

### *Study design and population*

This cross-sectional study was performed between January 2022 and July 2023 among students attending twelve Italian universities (University of Bari Aldo Moro, University of Bologna Alma Mater Studiorum, University of Campania “Luigi Vanvitelli”, University of Catanzaro “Magna Græcia”, University of Eastern Piedmont “Amedeo Avogadro”, University of Messina, University of Modena and Reggio Emilia, University of Naples “Parthenope”, University of Parma, University of Rome “Foro Italico”, Sapienza University of Rome, University of Turin). Undergraduates were invited to participate during classes by a researcher who explained the aims of the investigation and guaranteed the respect of anonymity and privacy in data collection and elaboration. An electronic questionnaire was used to collect participants’ information. A link to the questionnaire was provided to the students during the presentation of the study and they were also invited to spread the questionnaire among their colleagues who did not attend lessons. No incentives were provided to fill in the questionnaire. Participants were allowed to complete the questionnaire when they prefer, even out of classes. Universities were chosen by convenience. Considering a total population of 438,555 students in the involved Universities, a sample of at least 384 undergraduates would have been required assuming a 95% confidence level and a 50% response proportion. The study was carried out respecting the principles of the Declaration of Helsinki. The protocol of the study was approved by the Ethical Board of the University of Rome “Foro Italico” (CAR 140/2022).

In the first part of the questionnaire, students were asked to report their sociodemographic characteristics (age, gender, parents’ educational level, university, residential status (residing in the university area, commuter, off-site), living conditions (alone, with familiars, with parents, with other non-familiar cohabitants), sentimental status (single, engaged but not married, married), occupational status (working or not, working frequency and main time slot). In the second section of the questionnaire information regarding lifestyle and sleep-related behaviors were collected: dietary habit (Mediterranean, vegetarian/vegan, weight loss diet, diet for a health condition, supplemented diet, no particular dietary regimen), weight and height for the body mass index (BMI) calculation, smoking habit (smoking or not, frequency of smoking, use of cigarettes/cut tobacco, heat tobacco devices, electronic cigarettes, more than one product),

consumption of alcoholic beverages (consumption or not, frequency of consumption, type of beverages consumed, consumption during or out of meals), consumption of coffee, energy drinks, cannabis, cocaine, ecstasy, amphetamine, hallucinogens, opiates, non-psychoactive-drugs (NPDs), minutes per week of moderate-vigorous physical activity (MVPA), participation in sport (practicing or not, recreational or competitive level, individual or group sports), number of hours usually spent using electronic devices during the day, habit of studying during the night, reading paper or electronic books, watching films, studying on paper or electronic devices, videogaming, chatting or visiting social media, practicing other non-screen related recreational activities or physical activity before sleep. An additional question was posed to explore if the quantity/quality of their sleep changed in the course of the COVID-19 pandemic (no change, decreased, increased).

The third section of the questionnaire consisted in the Italian Version of the Pittsburgh Sleep Quality Index (PSQI) (31). The statistical software STATA was used to calculate the Cronbach’s alpha index. A coefficient equal to 0.74 was obtained, indicating acceptable internal consistency.

A commitment statement was posed at the beginning of the questionnaire as attention check question. The mean time required to complete the questionnaire was 13 minutes. All the questions were mandatory. Therefore, only fully completed questionnaires were collected and used for the subsequent statistical analyses.

### *Statistical analyses*

Continuous variables were expressed by mean and standard deviation (SD) or median and interquartile range (IQR) values on the basis of their distribution, while categorical variables were reported as number and percentage of respondents for each category. BMI was used to classify respondents’ nutritional status (underweight, normal weight, overweight and obese), as recommended by the World Health Organization (<https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---who-recommendations>). Participants were classified as “good quality sleepers” or “poor quality sleepers” on the basis of their PSQI score, considering the cut-off value of 5, as previously defined (31).

Depending on data distribution, the Student’s *t* test for independent samples, the Wilcoxon rank sum test and the chi-squared test were used to highlight possible differences in the characteristics of the

respondents between participants grouped by PSQI score. In order to identify variables possibly related with sleep quality, a multiple logistic regression analysis was performed by including as independent those socio-demographic and behavioral variables that showed significant differences between sleep quality groups in the univariate analyses. To this aim, some answers were grouped to obtain dichotomous variables: diet (no particular regimen = 0, other regimens = 1); smoking frequency (non-smoker/quitter = 0, smoker = 1), type of smoking (cigarettes or tobacco = 0, electronic devices = 1), sport (no = 0, yes = 1). Age and MVPA/week values were classified as  $\leq$  median value = 0 or  $>$  median value = 1.

The value of  $p = 0.05$  was assumed as significance threshold. The statistical software IBM SPSS, version 28.0, was used for the analyses.

## Results

A total of 1,674 complete questionnaires were collected. Table 1 shows the sociodemographic and behavioral characteristics of participants.

The sample was mainly composed by females, commuters, and students attending life science courses, living with relatives, and engaged in a relationship. The educational level of participants' parents was mainly high school. The majority of the sample did not work; about the half of workers was occupied mainly in the afternoon.

Table 1 - Characteristics of the sample

Variable	Values
Age (years)	
<i>mean</i> ± <i>SD</i>	24.06±4.56
Gender <i>n</i> (%)	
female	1,193 (71.3)
male	468 (28.0)
other/no answer	13 (0.8)
Mother educational level <i>n</i> (%)	
mandatory	411 (24.6)
high-school	786 (47.0)
degree	477 (28.5)
Father educational level <i>n</i> (%)	
mandatory	475 (28.4)
high-school	787 (47.0)
degree	412 (24.6)

Geographical area <i>N</i> (%)	
North	527 (31.5)
Center	508 (30.3)
South	639 (38.2)
Study area <i>N</i> (%)	
life sciences	1,291 (77.1)
other	383 (22.9)
Residential status <i>N</i> (%)	
resident in the area	498 (29.7)
commuter	627 (37.5)
off-site	549 (32.8)
Living condition <i>N</i> (%)	
alone	96 (5.7)
with relatives	1,078 (64.4)
with partner	142 (8.5)
with cohabitants	358 (21.4)
Relationship status <i>N</i> (%)	
single	687 (41.0)
engaged, not married	936 (55.9)
married	51 (3.0)
Working activity <i>N</i> (%)	
none	907 (54.2)
<once a week	76 (4.5)
at least once a week	143 (8.5)
>once a week	260 (15.5)
every day	288 (17.2)
Main working time slot <i>N</i> (%)	
morning	247 (32.2)
afternoon	385 (50.2)
evening	89 (11.6)
night	46 (6.0)
Diet <i>N</i> (%)	
no particular regimen	780 (46.6)
Mediterranean diet	492 (29.4)
vegetarian or vegan	59 (3.5)
weight loss diet	179 (10.7)
diet for particular health condition	63 (3.8)
diet with temporary supplementation	101 (6.0)
BMI (kg/m <sup>2</sup> )	
<i>mean</i> ± <i>SD</i>	23.03±3.78
category <i>n</i> (%)	
underweight	95 (5.7)
normal weight	1,054 (63.0)
overweight	271 (16.2)
obese	254 (15.2)
Smoking <i>N</i> (%)	
no	1,011 (60.4)
yes, <3 times a week	123 (7.3)
yes, 4-6 times a week	48 (2.9)
yes, at least once a day	405 (24.2)
quitter	87 (5.2)
Smoking type <i>N</i> (%)	
cigarettes or cut tobacco	274 (16.4)
heat tobacco devices	184 (11.0)
electronic cigarettes	106 (6.3)
more than one product	94 (5.6)

Alcohol use <i>N</i> (%)	
no	288 (17.2)
yes, ≤once a month	397 (23.7)
yes, 2-4 times a month	606 (36.2)
yes, 2-3 times a week	284 (17.0)
yes, ≥times a week	28 (1.7)
yes, every day	71 (4.2)
Alcoholic beverage consumed <i>N</i> (%)	
wine	532 (38.7)
beer	525 (38.2)
spirits	318 (23.1)
Alcohol use time <i>N</i> (%)	
during meal	592 (42.7)
out of meal	794 (57.3)
MVPA/week (minutes)	
median ( <i>IQR</i> )	120 (180)
Sport <i>N</i> (%)	
no	805 (48.1)
yes, recreational	733 (43.8)
yes, competitive	136 (8.1)
Sport category <i>N</i> (%)	
endurance	461 (54.9)
strength	378 (45.1)
Sport type <i>N</i> (%)	
individual	688 (80.4)
group	168 (19.6)
Night sleep (hours)	
mean± <i>SD</i>	6.89±1.28
PSQI (score)	
mean± <i>SD</i>	
<i>N</i> (%)	6.23±3.05
≤5	747 (45.4)
>5	927 (55.4)

As for the lifestyle, about the half of respondents did not follow particular diet regimens and the majority had a normal weight and were non-smokers; smokers preferred the use of traditional cigarettes or tobacco. Alcohol use was reported by the great majority of respondents: they consumed mainly wine and beer 2-4 times a month and out of the meals. The sample showed a weekly PA level lower than that recommended, and less than the half was engaged in sport. Recreational, endurance and individual sports were more commonly reported by those who exercised. As for sleep, the mean number of hours slept was lower than that recommended, and the mean PSQI was about 6 out of 21.

A total of 927 (54.6%) of participants showed a PSQI >5 and were identified as “poor quality sleepers”. The univariate comparisons between respondents with poor and good sleep quality were reported in Table 2.

“Poor quality sleepers” showed higher age, greater proportions of females and students attending southern universities than “good quality sleepers”. As for lifestyle, higher proportions of individuals who did not follow any dietary regimen, who commonly used energy drinks, cannabis, and hallucinogens, reporting lower levels of PA and sport practice, mainly individual sports, who smoked with a higher frequency and mainly traditional cigarettes or tobacco, were registered among “poor quality sleepers”. As for the sleep-related behaviors, this group reported more time

Table 2 - Comparison of sociodemographic and behavioral characteristics between “poor quality sleepers” and “good quality sleepers” with related p values

Variable	Poor quality sleepers N=927	Good quality sleepers N=747	p value
Age mean± <i>SD</i>	24.2±4.7	23.8±4.3	0.008
Gender <i>n</i> (%)			
female	687 (74.1)	506 (67.7)	0.016
male	233 (25.1)	235 (31.5)	
other/no answer	7 (0.8)	6 (0.8)	
Mother's educational level <i>n</i> (%)			
mandatory	228 (24.6)	183 (24.5)	0.992
high-school	436 (47.0)	350 (46.9)	
degree	263 (28.4)	214 (28.6)	
Father's educational level <i>n</i> (%)			
mandatory	273 (29.4)	202 (27.0)	0.548
high-school	428 (46.2)	359 (48.1)	
degree	226 (24.4)	186 (24.9)	



Geographical area <i>n</i> (%)			
North	257 (27.7)	270 (36.1)	<0.001
Center	282 (30.4)	226 (30.3)	
South	388 (41.9)	251 (33.6)	
Study area <i>n</i> (%)			
life sciences	724 (78.1)	567 (75.9)	0.287
other	203 (21.8)	180 (24.0)	
Residential status <i>n</i> (%)			
resident in the area	263 (28.3)	235 (31.5)	0.349
commuter	358 (38.6)	269 (36.0)	
off-site	306 (33.1)	243 (32.5)	
Living condition <i>n</i> (%)			
alone	62 (6.7)	34 (4.5)	0.295
with relatives	595 (64.2)	483 (64.7)	
with partner	76 (8.2)	66 (8.8)	
with cohabitants	194 (20.9)	164 (22.0)	
Relationship status <i>n</i> (%)			
single	379 (40.9)	308 (41.2)	0.561
engaged, not married	516 (55.7)	420 (56.2)	
married	32 (3.4)	19 (25.4)	
Working activity <i>n</i> (%)			
none	499 (53.8)	408 (54.6)	0.577
<once a week	37 (4.0)	39 (5.2)	
at least once a week	76 (82.0)	67 (9.0)	
>once a week	152 (16.4)	108 (14.5)	
every day	163 (17.6)	125 (16.7)	
Main working time slot <i>n</i> (%)			
morning	149 (34.8)	98 (29.0)	0.105
afternoon	196 (45.8)	189 (55.7)	
evening	55 (12.8)	34 (10.0)	
night	28 (6.6)	18 (5.3)	
Diet <i>n</i> (%)			
no particular regimen	448 (48.3)	332 (44.4)	0.003
Mediterranean diet	258 (27.8)	234 (31.3)	
vegetarian or vegan	33 (3.6)	26 (3.5)	
weight loss diet	99 (10.7)	80 (10.7)	
diet for particular health condition	46 (5.0)	17 (2.3)	
diet with temporary supplementation	43 (4.6)	58 (7.8)	
BMI (kg/m <sup>2</sup> )	23.1±3.8	22.9±3.6	0.066
mean±SD underweight	59 (6.4)	36 (4.8)	
normal weight	562 (60.6)	492 (65.9)	0.049
overweight	167 (18.0)	104 (13.9)	
obese	139 (15.0)	115 (15.4)	
Smoking <i>n</i> (%)			
no	510 (55.0)	501 (67.1)	<0.001
yes, <3 times a week	74 (8.0)	49 (6.6)	
yes, 4-6 times a week	30 (3.2)	18 (2.4)	
yes, at least once a day	254 (27.4)	151 (20.2)	
quitter	59 (6.4)	28 (3.7)	
Smoking type <i>n</i> (%)			
cigarettes or cut tobacco	175 (42.3)	99 (40.6)	<0.001
heat tobacco devices	108 (26.1)	76 (31.1)	
electronic cigarettes	63 (15.2)	43 (17.6)	
more than one product	68 (16.4)	26 (10.7)	

Alcohol use <i>n</i> (%)			
no	148 (16.0)	140 (18.7)	
yes, ≤once a month	222 (23.9)	175 (23.4)	
yes, 2-4 times a month	332 (35.8)	274 (37.0)	0.209
yes, 2-3 times a week	159 (17.2)	125 (16.7)	
yes, ≥times a week	19 (2.0)	9 (1.2)	
yes, every day	47 (5.1)	24 (3.2)	
Alcoholic beverage consumed <i>n</i> (%)			
wine	292 (37.8)	240 (39.9)	
beer	297 (38.4)	228 (37.9)	0.397
spirits	184 (23.8)	134 (22.2)	
Alcohol use time <i>n</i> (%)			
during meal	326 (41.9)	266 (43.8)	0.310
out of meal	452 (58.1)	342 (56.2)	
Coffee consumption <i>n</i> (%)			
no	139 (15.0)	111 (14.9)	0.939
yes	788 (85.0)	636 (85.1)	
Energy drink consumption <i>n</i> (%)			
no	726 (78.3)	619 (82.9)	0.020
yes	201 (21.7)	128 (17.1)	
Cannabis use <i>n</i> (%)			
no	806 (86.9)	674 (90.2)	0.037
yes	121 (13.1)	73 (9.8)	
Cocaine use <i>n</i> (%)			
no	920 (99.2)	744 (99.6)	0.351
yes	7 (0.8)	3 (0.4)	
Amphetamine use <i>n</i> (%)			
no	921 (99.3)	744 (99.6)	0.494
yes	6 (0.7)	3 (0.4)	
Hallucinogens use <i>n</i> (%)			
no	919 (99.1)	746 (99.9)	0.043
yes	8 (0.9)	1 (0.1)	
Ecstasy use <i>n</i> (%)			
no	923 (99.6)	745 (99.7)	0.806
yes	4 (0.4)	2 (0.3)	
Opiates use <i>n</i> (%)			
no	926 (99.9)	747 (100)	0.369
yes	1 (0.1)	0 (0.0)	
Non psychoactive drugs use <i>n</i> (%)			
no	926 (99.9)	747 (100)	0.369
yes	1 (0.1)	0 (0.0)	
MVPA/week (minutes)			
median ( <i>IQR</i> )	100 (40)	120 (60)	<0.001
Sport <i>n</i> (%)			
no	472 (50.9)	333 (44.6)	0.002
yes, recreational	397 (42.8)	336 (45.0)	
yes, competitive	58 (6.3)	78 (10.4)	
Sport category <i>n</i> (%)			
endurance	237 (54.0)	224 (56.0)	0.558
strength	202 (46.0)	176 (44.0)	
Sport type <i>n</i> (%)			
individual	375 (83.5)	313 (76.9)	0.015
group	74 (16.5)	94 (23.1)	
Daily use of electronic devices			
≤2 hours	462 (49.8)	487 (65.2)	<0.001
>2 hours	465 (50.2)	260 (34.8)	

Studying in the night <i>n</i> (%)			
no	389 (42.0)	445 (59.6)	<0.001
yes	538 (58.0)	302 (40.4)	
Watching films before sleep <i>n</i> (%)			
no	184 (19.8)	139 (18.6)	0.522
yes	743 (80.2)	608 (81.4)	
Reading paper books before sleep <i>n</i> (%)			
no	608 (65.6)	490 (65.6)	0.997
yes	319 (34.4)	257 (34.4)	
Reading e-book before sleep <i>n</i> (%)			
no	838 (90.4)	680 (91.0)	0.659
yes	89 (9.6)	67 (0.9)	
Studying on paper before sleep <i>n</i> (%)			
no	587 (63.3)	542 (72.6)	<0.001
yes	340 (36.7)	205 (27.4)	
Studying with electronic devices before sleep <i>n</i> (%)			
no	604 (65.2)	551 (73.8)	<0.001
yes	323 (34.8)	196 (26.2)	
Playing videogames before sleep <i>n</i> (%)			
no	758 (81.8)	652 (87.3)	0.002
yes	169 (18.2)	95 (12.7)	
Other (non electronic) recreational activities <i>n</i> (%)			
no	738 (79.6)	620 (83.0)	0.078
yes	189 (20.4)	127 (17.0)	
Communication via chat before sleep <i>n</i> (%)			
no	88 (9.5)	99 (13.3)	0.015
yes	839 (90.5)	648 (86.7)	
Visit social network before sleep <i>n</i> (%)			
no	81 (8.7)	95 (12.7)	0.008
yes	846 (91.3)	652 (87.3)	
Physical activity before sleep <i>n</i> (%)			
no	845 (91.2)	674 (90.2)	0.516
yes	82 (8.8)	73 (9.8)	
Sleep quality after the pandemic <i>n</i> (%)			
no change	391 (42.2)	465 (62.2)	<0.001
decreased	392 (42.3)	158 (21.2)	
increased	144 (15.5)	124 (16.6)	

spent using electronic devices during the day and were more used to study by night than their counterparts; they showed higher proportions of those who study, both on paper and screen, play videogames and use chat or social media before sleep. A higher proportion of “poor quality sleepers” reported a decrease in sleep quality related to the pandemic respect to “good quality sleepers”.

The results of the regression analysis are shown in Table 3. A better sleep quality seems to be associated with lower age, attending universities in Northern Italy, less time spent on electronic devices in the course of the day, and not being used to study at night.

## Discussion

The results of this study highlight that more than half the sample analyzed showed poor sleep quality. The reason for this finding could be detected in the characteristics of the population studied. In fact, the student’s transition to university is marked by changes in living conditions, increased responsibilities, and social obligations that can affect sleep (32,33). Furthermore, even though evidence on this issue is not consistent and comes mainly from correlational, and not experimental, studies, sleep can be influenced by numerous sociocultural factors, such as sleeping arrangements, evening mealtimes, and leisure



Table 3 - Results of the regression analysis performed considering good sleep quality as outcome.

Variable	Odds Ratio (CI95%)	p value
Age		
≤23 years	1.550 (1.139-2.108)	0.005
>23 years	<i>Reference</i>	
Gender		
female	0.110 (0.007-1.679)	0.112
male	0.202 (0.013-3.112)	0.251
other	<i>Reference</i>	
Geographical area		
North	2.386 (1.644-3.464)	<0.001
Center	1.223 (0.846-1.768)	0.285
South	<i>Reference</i>	
Diet		
no particular regimen	0.970 (0.715-1.314)	0.843
specific diet	<i>Reference</i>	
BMI		
underweight	0.702 (0.421-1.169)	0.174
normal weight	1.108 (0.829-1.481)	0.486
overweight	0.842 (0.583-1.217)	0.361
obese	<i>Reference</i>	
Energy drink use		
no	1.311 (0.904-1.902)	0.153
yes	<i>Reference</i>	
Cannabis use		
no	1.061 (0.657-1.712)	0.809
yes	<i>Reference</i>	
Hallucinogens use		
no	1.981 (0.135-29.099)	0.618
yes	<i>Reference</i>	
Smoking habit		
no	1.148 (0.799-1.648)	0.455
yes	<i>Reference</i>	
Smoking type		
traditional	0.705 (0.436-1.138)	0.152
other	<i>Reference</i>	
MVPA		
≤120 min/week	1.136 (0.831-1.555)	0.424
>120 min/week	<i>Reference</i>	
Sport		
no	0.789 (0.510-1.221)	0.288
yes	<i>Reference</i>	
Sport type		
individual	0.692 (0.466-1.027)	0.067
group	<i>Reference</i>	
Daily use of electronic devices		
≤2 hours	1.849 (1.352-2.529)	<0.001
>2 hours	<i>Reference</i>	
Studying in the night		
no	2.006 (1.436-2.802)	<0.001
yes	<i>Reference</i>	
Studying on paper before sleep		
no	1.281 (0.891-1.840)	0.181
yes	<i>Reference</i>	

Studying with electronic devices before sleep		
no	0.849 (0.601-1.199)	0.353
yes	<i>Reference</i>	
Playing videogames before sleep		
no	1.768 (1.161-2.692)	0.008
yes	<i>Reference</i>	
Communication via chat before sleep		
no	1.149 (0.687-1.921)	0.596
yes	<i>Reference</i>	
Visit social network before sleep		
no	1.138 (0.692-1.871)	0.611
yes	<i>Reference</i>	

activities, which can markedly change during the university years (34). In our study, “poor quality sleepers” showed higher proportions of individuals with unhealthy lifestyles, such as uncontrolled diet, low levels of physical activity and of sport participation, and use of tobacco and other substances. This is in line with previous studies suggesting that university students are more likely to engage in risky behaviors and this can negatively impact their sleep quality (16-18). However, the regression analysis confirmed only a few of these associations. In accordance with previous studies, a poorer sleep quality was found to be related with higher age, and then with aging processes, variations in hormones production, and life transitions (10, 35).

Furthermore, in our sample, students attending universities in Southern Italy showed a poorer sleep quality respect to those attending Northern Italian university. In continuity with studies performed on the Italian territory, our findings suggest that the socio-cultural differences existing between Northern and Southern Italy may also influence levels of the youth sleep and well-being, as previously reported in literature (36, 37).

Moreover, according to our research, poorer quality sleepers tend to spend more time using electronic devices during the day and are more likely to study and play videogames before bedtime compared to those who sleep well. Indeed, spending time on screens, particularly before going to bed, can result in various issues including less sleep time, low-quality sleep, and difficulty functioning during the day (38). When considering the relationship between electronic device usage and students’ sleep, there are two important factors to keep in mind. The first is the time of device use before bedtime, and the second is the type of media being used. Studies have found that using electronic devices before bedtime can have a more significant

impact on sleep quality than the total amount of time spent using them (38). Our study did not find any correlation between watching films or reading papers or e-books before sleep and a poorer sleep quality (39). However, correlations were found with the use of electronic devices for gaming and with the total daily screen time. Further research is necessary to determine how the different types of electronic devices can impact sleep quality. There are different theories regarding the relationship between screen use before bedtime and sleep. One theory is that the light emitted by electronic screens affects sleep, while another suggests that engaging in electronic entertainment before bed can impact sleep (40). Conversely, it should also be considered that students who struggle to sleep may use electronic devices to help them fall asleep at night (40). This could explain why some individuals opt to study using screens, play video games, or use chat or social media before going to bed, as observed in our population. Therefore, the use of electronic devices for recreational or work activities can have positive or negative effects on individual’s sleep (38-40).

In order to improve long-term sleep quality and duration, sleep hygiene practices should be recommended, including achieving seven to nine hour of sleep, maintaining a consistent sleep/wake schedule and a regular bedtime routine, engaging in regular exercise, adopting a contemplative practice, avoiding caffeine, alcohol, heavy meals, and light exposure in the afternoon/evening which seem to be associated with fragmented poor-quality sleep (12).

Our study has both strengths and limitations. We believe it is the first of its kind in our country, as it has investigated sleep behaviors in a wide range of students from different degree courses at universities in Northern, Central, and Southern Italy. However, the universities were chosen by

convenience, not randomly, so the sample cannot be considered representative of the entire undergraduate population in Italy. Additionally, students were asked to participate during their classes, which means those who were absent may not have been informed about the study, although we asked participants to share the link among their peers. Even the high number of female participants in our sample (71.3%), which exceeds the proportion registered in the corresponding undergraduate population (58.5%), may be due to a higher participation in classes by female students. Therefore, the different gender distribution between sleep quality groups should be considered with caution, also because it did not find evidence in the regression analysis. Furthermore, the data were collected through an electronic questionnaire and self-reported, which may have resulted in some inaccuracies. Lastly, since the aim of this study was limited to ascertaining potential factors contributing to sleep quality, possible pathological profiles were not investigated in depth through specific scales as in previous experiences (28). Considering the relationship between sleep and mental health, this aspect should be investigated in future research.

A further consideration should be done regarding the COVID-19 pandemic. In the questionnaire, we asked participants to express their perception of possible changes that occurred in their sleep quality following the pandemic. The results are in line with other investigations performed in the same population and suggest the possible impact of changed behaviors on people's sleep habits (24,25,41). However, due to the cross-sectional design of the study and the need to contain the length of the questionnaire, it was not possible to perform a pre-post pandemic comparison and to study in depth these changes and their possible determinants. The effects of the COVID-19-related social and behavioral modifications on sleep quality should therefore be analyzed in the future.

## Conclusions

In agreement with recent research, the results of this study suggest that sociocultural and behavioral factors are related with undergraduates' sleep quality. In particular, it appears that sleep quality of Italian undergraduates can be related with geographical area and use of electronic devices. However, due to the cross-sectional nature of our investigation, detailed experimental studies are needed to confirm or reject these associations. Anyway, the poor sleep quality

shown by a great proportion of the sample highlights the opportunity to increase the students' awareness on the role of sleep quality in health maintenance and on the impact that some behaviors may have on sleep. In a public health perspective, this could lead individuals to improve their sleep quality and prevent possible associated disorders.

## Riassunto

### *La qualità del sonno negli studenti universitari italiani: lo studio multicentrico UnSleep*

**Background.** Le evidenze scientifiche dimostrano che una scarsa qualità del sonno può portare a diversi problemi di salute. Questo studio aveva lo scopo di indagare i patterns del sonno in un campione di studenti universitari italiani e a identificare fattori che potrebbero contribuire alla sua qualità.

**Disegno dello studio.** Studio trasversale.

**Metodi.** Un questionario elettronico riguardante caratteristiche socio-demografiche, stili di vita e abitudini legate al sonno, che includeva anche le domande del questionario Pittsburgh Sleep Quality Index (PSQI), è stato distribuito tra gennaio 2022 e luglio 2023 tra gli studenti appartenenti a 12 università situate nel nord, centro e sud Italia.

**Risultati.** Su un totale di 1674 questionari raccolti, i partecipanti (età media  $24,06 \pm 4,56$  anni, 71,3% F) hanno riportato un numero medio di ore di sonno notturno pari a  $6,89 \pm 1,28$  ore. 927 intervistati (54,6%) hanno mostrato una scarsa qualità del sonno (PSQI  $>5$ ). L'analisi di regressione ha mostrato che una migliore qualità del sonno è associata ad un'età più bassa, alla frequenza delle università del Nord Italia, al minor tempo trascorso davanti ai dispositivi elettronici durante il giorno, al non essere abituati a studiare di notte e a non giocare ai videogiochi prima di dormire.

**Conclusione.** Dal punto di vista della salute pubblica, i risultati suggeriscono che gli operatori di sanità pubblica dovrebbero sensibilizzare i giovani sull'importanza della qualità del sonno per mantenere una buona salute, nonché sull'impatto che determinati comportamenti possono avere sul sonno.

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