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ORIGINAL ARTICLE

Cross-sectional study identifying the prevalence of sleep disturbances and associated risk factors in medical students

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The authors have declared that no competing interests exist

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Summary

Sleep disturbances can lead to poor academic and health outcomes. There is a gap in the current literature regarding the prevalence of sleep disturbances and their impact on various associated factors. Our study seeks to understand the prevalence of sleep disturbances, and their impact on medical students.

A cross-sectional survey was conducted at the University of Belgrade, Faculty of Medicine between April 2023 and September 2023. A sample of 70 medical students provided answers to a novel questionnaire, the BDI, and the PSQI, to evaluate lifestyle habits and demographics, depressive symptoms, and sleep quality.

Univariate linear regression identified chronic diseases, stress experienced in the past 12 months, sleep duration, difficulty falling or staying asleep, sleep pill consumption, and BDI score as strong predictors of the PSQI global score. Multivariate linear regression analysis showed that chronic diseases and depression were the most influential factors influencing participants' sleep quality.

Sleep quality in students is significantly affected by chronic diseases and depressive symptoms, highlighting the need for preventive measures.

Key words: sleep quality, depression, chronic disease, PSQI, BDI, students

INTRODUCTION

Sleep quality and mental health are closely linked in university students and can be compromised by various external factors, potentially leading to poor academic performance and overall health outcomes. Sleep quality refers to the assessment of how well an individual sleeps and is characterized by factors such as sleep efficiency, sleep latency, sleep duration, and wake after sleep onset (1). Sleep quality is known to influence mental health, with previous studies identifying correlations between poor sleep quality and depressive symptoms (2).

Disturbances in sleep quality can create poor outcomes in individuals and are significantly influenced by psychological, social, as well as environmental factors. The Pittsburgh Sleep Quality Index (PSQI) is the standardized scale which can effectively evaluate the prevalence of disturbances in sleep quality. Additionally, a clear association has been found between sleep patterns and depressive symptoms, with 19% of study participants exhibiting depressive symptoms, as measured by the Beck Depression Inventory (BDI). These individuals also experienced lower sleep quality, increased sleep latency, and higher consumption of sleeping pills (2).

Among students, technology use – particularly internet and phone usage – is a major contributor to poor sleep quality. Internet usage among health students has been associated with increased rates of sleep quality issues and depression, by 42.3% and 8.9%, respectively (3). Phone usage has been shown through multiple previous studies to negatively impact sleep and mental health. The overarching result is that phone usage, and sometimes addiction, are highly associated with poorer sleep quality and worse mental health across the student population (4-6). Contributing factors include increased nighttime checking of one's phone (5) and hours spent on one's phone at daytime (6).

Furthermore, gender differences create a discrepancy in sleep quality and mental health in university students, as determined by a previous study in 2020, which found that females had a higher prevalence of poor sleep quality, insomnia, and daytime sleepiness by 5.5%, 6.8%, and 4.5%, respectively (7). Additionally, female students have also been shown to have a higher risk of depressive symptoms (2).

Students' academic lifestyles have been shown to contribute to the prevalence of poor sleep quality and mental health. Factors such as "all-nighters" and burnout have been linked to poor academic performance and depression (8), as well as impaired sleep quality (9).

There is limited literature on interventions for this issue; however, one study found that two cognitive-behavioral workshops – the Sleep and Wakefulness Program and the Perseverance Program – resulted in a decrease in depression both before and after workshop attendance (10). This highlights potential approaches to address this concern within the student population.

Although research on the prevalence of sleep disturbances and the impact of depression in university students is limited, previous studies have shown a clear association between the two. This underscores the need for further investigation into the factors contributing to this relationship. This association can be problematic for students' academic performance, health, and overall success, making this a pertinent problem to explore further. Keeping in mind all the above mentioned, the aim of our study was to assess the prevalence of sleep disturbances and consequent risk factors in the cohort of medical students.

MATERIAL AND METHODS

A cross-sectional, comprehensive survey was conducted at the University of Belgrade, Faculty of Medicine between April 2023 and September 2023. A sample of 70 medical students out of the total of280, in various years of study, who had their studies in English, voluntarily participated in an online survey, with their responses remaining anonymous. The survey aimed to gather information regarding students' demographics, sleep habits, presence of depressive symptoms, and overall lifestyle. The study was approved by the Institutional Review Board of the Faculty of Medicine, University of Belgrade.

A new 33-question questionnaire was developed by a member of the research team, following an initial literature review to identify the relevant and essential questions to include.

The Beck Depression Inventory (BDI) was administered to students in order to gather information on possible depressive symptoms (11). This questionnaire included 21 areas related to depression. The answers were collected, totaled, and scored by a research team member based on a scale, with 0 to 13 points = no depressive symptoms, 14 to 19 points = mild depressive symptoms, 20 to 28 points = moderate depressive symptoms, and > 28 points = severe depressive symptoms.

The Pittsburgh Sleep Quality Inventory (PSQI) was also administered to students, in order to gather information on their sleep habits, sleep disturbances, and the overall quality of sleep (12). This questionnaire contained 19 questions, which were self-rated, as well as 5 partner or roommate questions, if available. However, only the self-rated questions were scored. The 19 questions were used to form 7 component scores, with ranges of 0-3, 0 meaning no difficulties with sleep, and 3 meaning severe difficulties with sleep and high dysfunction. The component scores were subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, the use of sleeping medication, and daytime dysfunction. These component scores were added together to form the Global PSQI Score, which is indicative of the level of sleep quality, and ranges from

0-21 points, 0 being no difficulty overall, and 21 being severe difficulty in all areas mentioned above regarding sleep quality (12).

STATISTICAL ANALYSIS

The primary analysis involved descriptive summary statistics for estimating socio-demographic characteristics of participants. The level of statistical significance was set at $p < 0.05$. Pearson's or Spearman's correlation coefficients (r or ρ), depending on normality of distribution were used to investigate the association between the PSQI and the BDI scores. In data analysis, univariate and multivariate linear regression models were used. All analyses were performed using Statistical Package for Social Sciences (SPSS), version 17.0.

RESULTS

Demographic and social characteristics of study participants are presented in **Table 1**. Among the study participants, there were more females than males, with an average age of 23 years. Half of the participants were born in Serbia, with Canada, USA, and Germany being countries with >1 participant. The majority of participants identified themselves as Caucasian. The majority of study participants were in their 6th year of medical school, with an average GPA of 8.3 on a 5-10 scale. Most participants reported living with their parents or in a rented apartment, and the average monthly allowance was 535 euros.

Distribution of study participants regarding their health and lifestyle habits are presented in **Table 2**. Lifestyle habits include smoking, coffee and alcohol consumption, physical activity, internet use, job positions, stress, and sleeping. The majority of study participants reported no history of chronic disease, were nonsmokers, and more than half had never consumed coffee. Alcohol consumption was varied, however most participants consumed alcohol either 1-3 times per month or less than once a month. In terms of activity, the largest proportion of study participants engaged in sports-related activities weekly, participated in recreational activities daily, and exercised 2-3 times per week, primarily through active sports or workouts. Participants spent most of their time sitting for over 8 hours daily and spent up to 5 hours of their free time on the computer. Study participants reported spending the most time on schoolwork and studying, with an average of 3-5 hours. Over 80% of participants did not have a student job outside their education, while the 20% who did worked an average of 13 hours per week. Most participants described experiencing stress occasionally over the past 12 months, and nearly 60% reported sleeping 6-8 hours per night. Study

participants reported that their most common issue was difficulty falling or staying asleep, with 80% occasionally using sleeping pills.

Table 1. Demographic and social characteristics of study participants

Variable	Value
Gender	
Male	26 (37.1%)
Female	44 (62.9%)
Age (years)	
Mean±SD	23.0±2.6
Range	19-33
Country of Birth	
Serbia	35 (50%)
Canada	4 (5.7%)
USA	4 (5.7%)
Germany	3 (4.3%)
Other	24 (34.3%)
Ethnic Origin	
Caucasian	56 (80%)
Mixed ethnicity	4 (5.7%)
Asian/Pacific Islander	4 (5.7%)
Persian	2 (2.9%)
African	1 (1.4%)
Arabic	1 (1.4%)
Hispanic/Latino	1 (1.4%)
Indian	1 (1.4%)
Year of study	
First	14 (20%)
Second	8 (11.4%)
Third	7 (10%)
Fourth	16 (22.9%)
Fifth	7 (10%)
Sixth	18 (25.7%)
Grade Point Average (GPA)*	
Mean±SD	8.3±0.8
Range	6-10
Current Housing	
Living with parents	33 (47.1%)
Rented apartment	24 (34.3%)
Own apartment	10 (14.3%)
Student housing	3 (4.3%)
Amount of money received per month (EUR)	
Mean±SD	535.5±609.2
Range	0-3,000

*GPA is weighed on a scale of 5-10.

Mean and median values of PSQI scores are presented in **Table 3**. The median value of the PSQI global score was 6.0.

Depressive mood was measured by BDI, and median value of the BDI was 7.0, range 0-35. The distribution of the score categories for BDI is present in **Table 4**.

Correlation analysis showed a statistically significant relationship between the total score of PSQI and the following variables: BDI score (ρ=0.631, p=0.001), presence of chronic diseases (ρ=0.243, p=0.042), time spent sitting (ρ=0.260, p=0.029), frequency of feeling stressed in the past 12 months (ρ=0.428, p=0.001), sleep duration per night (ρ=-0.487, p=0.001), difficulties with falling asleep or stay asleep (ρ=-0.506, p=0.001).

Table 2. Distribution of study participants according to health and habits

Variable	Value
Presence of chronic diseases	
Yes	14 (20%)
No	56 (80%)
Smoking	
Nonsmokers	45 (64.3%)
Current smokers	18 (25.7%)
Past smokers	7 (10%)
Smoking duration (years)	
Mean±SD	5.2±4.4
Range	1-9
Number of cigarettes smoked per day	
Mean±SD	13.5±10.1
Range	1-40
Coffee consumption	
Daily	16 (22.9%)
Sometimes	18 (25.7%)
Never	36 (51.4%)
Alcohol consumption	
Never	13 (18.6%)
Less than once a month	21 (30%)
1-3 times/month	21 (30%)
Once a week	8 (11.4%)
2-4 times/week	7 (10%)
Frequency of sport-related activity	
Never	17 (24.3%)
Monthly	14 (20%)
Weekly	23 (32.9%)
Daily	16 (22.8%)
Frequency of recreational activity	
Rarely	16 (22.9%)
2 times per week	23 (32.9%)
Daily	31 (44.2%)
Frequency of physical activity	
Daily	21 (30%)
2 -3 times/week	26 (37.1%)
Once a week	3 (4.3%)
2-3 times/month	4 (5.7%)
Once a month	3 (4.3%)
Level of physical activity	
Active sport/workout	26 (37.1%)
Recreational exercise	20 (28.6%)
Walking	24 (34.3%)
Time spent sitting	
Up to 3 hours	3 (4.3%)
Up to 5 hours	25 (35.7%)
Up to 8 hours	29 (41.4%)
More than 8 hours	13 (18.6%)
Free time spent on computer	
1-2 hours	22 (31.4%)
Up to 5 hours	28 (40%)
More than 5 hours	12 (17.2%)
I don't use a computer in free time.	8 (11.4%)
Time spent on school work/studying	
1-3 hours	18 (25.7%)
3-5 hours	28 (40%)
5-7 hours	18 (25.7%)
More than 7 hours	6 (8.6%)
Presence of student job	
Yes	13 (18.6%)
No	57 (81.4%)

Variable	Value
Duration of student job per week (hours)	
Mean±SD	13.1±15.1
Range	2-50
Feelings of stress over past 12 months	
Rarely	5 (7.1%)
Sometimes	40 (57.2%)
Always	25 (35.7%)
Sleep duration	
4-6 hours	21 (30%)
6-8 hours	41 (58.6%)
8-10 hours	8 (11.4%)
Difficulties falling or staying asleep	
Yes	14 (20%)
No	25 (35.7%)
Sometimes	31 (44.3%)
Consumption of sleeping pills	
Yes	8 (11.4%)
No	5 (7.2%)
Sometimes	57 (81.4%)

Table 3. Pittsburgh Sleep Quality Index (PSQI) scores according to components

Component	Mean score±SD	Median, IQR*
Subjective sleep quality	1.2±0.8	1.0, 1.0
Sleep latency	1.2±1.1	1.0, 2.0
Sleep duration	0.9±0.9	1.0, 1.0
Habitual sleep efficiency	0.3±0.7	0.0, 0.0
Sleep disturbances	1.0±0.6	1.0, 0.0
Use of sleeping medication	0.2±0.7	0.0, 0.0
Daytime dysfunction	1.1±0.8	1.0, 0.0
PSQI global score	5.8±3.1	6.0, 3.0

*IQR = interquartile range.

Table 4. The distribution of the BDI score categories

BDI Score	Number of subjects	%
0-13	57	81.5
14-19	5	7.2
20-28	6	8.5
29+	2	2.8

According to results of univariate linear regression analysis, statistically significant predictors of the PSQI global score in our study include the presence of chronic diseases, feelings of stress in the past 12 months, sleep duration, difficulties with falling or staying asleep, consumption of sleeping pills, and BDI score **(Table 5)**.

All variables found to be statistically significant in the univariate linear regression analysis were included in the multivariate model. Multivariable linear regression analysis showed that independent predictors of the PSQI global scores included the presence of chronic diseases (unstandardized beta coefficient=1.89, standard error=0.70, p=0.009) and BDI score (unstandardized beta coefficient=0.25, standard error=0.04, p=0.001), in our settings.

Table 5. Linear regression analysis

Variable	Univariate analysis			Multivariate analysis		
	Unstandardized beta coefficient	95% confidence intervals	p	Unstandardized beta coefficient	95% confidence intervals	p
Gender	0.74	-0.82, 2.29	0.347			
Age	0.22	-0.07, 0.51	0.136			
Year of study	0.11	-0.30, 0.52	0.582			
GPA	-0.88	-1.93, 0.17	0.098			
Current housing	-0.24	-1.18, 0.70	0.612			
Amount of money received per month	-0.01	-0.01, 0.0	0.074			
Presence of chronic diseases	2.34	0.53, 4.14	**0.012**	1.89	0.49, 3.29	**0.009**
Smoking	0.01	-1.12, 1.14	0.986			
Coffee consumption	0.60	-0.32, 1.51	0.200			
Alcohol consumption	0.09	-0.54, 0.73	0.771			
Frequency of sport-related activity	-0.16	-0.85, 0.53	0.647			
Frequency of recreational activity	0.44	-0.51, 1.39	0.355			
Time spent sitting	0.81	-0.11, 1.73	0.082			
Free time spent on computer	0.57	-0.20, 1.34	0.144			
Time spent on school work/studying	0.17	-0.66, 0.99	0.688			
Presence of student job	-1.61	-3.52, 0.30	0.097			
Feelings of stress	2.33	1.18, 3.48	**0.001**			
Sleep duration	-2.41	-3.49, -1.33	**0.001**			
Difficulties falling or staying asleep	-2.0	-2.87, -1.15	**0.001**			
Consumption of sleeping pills	-1.17	-2.27, -0.06	**0.039**			
BDI score	0.26	0.18, 0.34	**0.001**	0.25	0.18, 0.34	**0.001**

*Bold values denote statistical significance

DISCUSSION

Our study examined the effect of lifestyle habits and mental health, specifically depression, on the sleep quality of medical students in Belgrade, Serbia using a novel questionnaire and two indexes, the Pittsburgh Sleep Quality Index (PSQI) and the Beck depression Inventory (BDI). The mean PSQI global score identified in this population was 5.8, on the scale 0-21. Of all factors incorporated in the study, univariate linear regression analysis identified chronic diseases, feeling of stress in the past 12 months, sleep duration, difficulty with falling or staying asleep, consumption of sleep pills, and BDI score as strong predictors for the PSQI global score, which identifies the level of sleep quality. Multivariate linear regression analysis revealed that the BDI score and the presence of chronic diseases had the strongest correlation and statistical significance with the PSQI score. This indicates that chronic diseases and depression were the most influential factors affecting the study participants' sleep quality. This indicates a need to prioritize the treatment of chronic disease and depression in this population to maximize their sleep quality, which holds a heavy effect on the academic performance and success of the study participants.

Similar studies have been conducted regarding the association between mental health, technology use, and sleep quality in the student population. Dudo et al. found an association between depressive symptoms and lower sleep quality as well as high sleep latency, and the consumption of sleeping pills, similarly using the BDI and

PSQI (2). This is consistent with our results, as it identifies a link in mental health and sleep quality of the medical student population. Becker et al. looked more specifically at PSQI, finding that through structural regression models, depression and anxiety were associated with PSQI sleep component disruptions, however depression specifically was uniquely associated with increased daytime dysfunction (13). While our study was consistent with the initial general association, we did not discover associations with daytime function. A study by Thacher also identified a growing trend between depressive symptoms and a single night of total sleep deprivation ("all-nighter"), further emphasizing the link between mental health and sleep quality (8). This raises the idea of how student's voluntary sleep behaviors influence their mental health and sleep quality outcomes.

We found correlations between the time spent on the computer and the BDI score in the study population, which is consistent with other studies investigating similar outcomes. For example, Kaya et al. discovered that students who used their smartphones for a mean of 7.85 hours per day had a statistically significant relationship to a higher PSQI and BDI point (6). Our results, demonstrated through correlational analysis, showed that internet usage – typically reported as 5 or more hours – was associated with the BDI score, aligning with the findings of Kaya et al. regarding the impact of technology use (6). Similarly, Shoval et al. found that frequent nighttime smartphone checking was linked to lower sleep quality. While we did not specifically investigate this, our find-

ings align with theirs, as difficulty staying asleep correlated with the PSQI global score. Students who frequently checked their phones at night struggled to maintain sleep (5). This similarly demonstrates the potential impacts of technology use on students' sleep quality.

Some studies found gender to be associated with sleep quality and depression, identifying females to have poorer sleep quality, a higher risk for depressive symptoms, and higher prevalence for insomnia and poor academic performance in females when compared to males (2, 7, 14), which was inconsistent with our results that did not identify a statistically significant correlation between gender and any of these factors.

Finally, burnout, which is a common occurrence for early phases in medical students, and sleep disorders, showed a bidirectional effect on students, including emotional exhaustion and daytime sleepiness, measured through PSQI and BDI scores, according to a study done by Pagnin et al (9). This highlights the impact of student lifestyle on sleep quality and mental health, and while we did not investigate burnout, it is important to note this finding when viewing our results and conducting future studies, taking into consideration student lifestyle habits based on education curriculum.

This study was conducted at a single medical faculty in Belgrade, Serbia. While the curriculum is standard across Serbian faculties and can be applied to other institutions within the country, it differs from those in other countries, which may limit the generalizability of the findings to student populations with different educational systems. Future studies should include comparisons across countries to provide more widely applicable insights.

Also, this study included a relatively low sample size of 70 students, making results limited in their external validity and generalizability. To increase the statistical power of the results, a larger sample size is needed for future studies.

This study was conducted at a specific point in students' lives, and may not capture events or emotions that could influence the results. Future research should consider a longitudinal approach to account for these factors over time.

Finally, the data collected in this study was self-reported, making the data less reliable compared to studies in which data is not self-reported. While the PSQI and BDI are established indexes, the demographic novel questionnaire is not, therefore this causes a potential limitation in data reliability. For future studies, an external measure of self-reported reliability is necessary to ensure accurate findings.

CONCLUSION

Sleep quality in the medical student population is heavily influenced by chronic diseases and depressive symptoms, as shown by multivariate linear regression analysis. Therefore, it is necessary to address symptoms of chronic diseases and depression properly and immediately, as well as apply preventative measures, for students to have improved sleep quality, and as a result, improved learning and academic performance.

Author Contributions

TP conceptualized the investigation and developed the methodology; SDJ collected data and created a database; AJ and VN performed statistical analysis; SDJ wrote the paper; all authors revised it for important intellectual content and approved the final submission.

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ISPITIVANJE PREVALENCIJE POREMEĆAJA SPAVANJA I UDRUŽENIH FAKTORA RIZIKA KOD STUDENATA MEDICINE

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Sažetak

Poremećaji spavanja mogu dovesti do slabijih akademskih i zdravstvenih ishoda. Prevalencija poremećaja spavanja i njihov uticaj na različite aspekte života još uvek nisu dovoljno poznati. Cilj ove studije je procena prevalencije poremećaja spavanja i efekata na zdravlje koje oni imaju, kod studenata medicine.

Metod: Istraživanje po tipu studije preseka sprovedeno je na Medicinskom fakultetu Univerziteta u Beogradu, u periodu od aprila do septembra 2023. Godine. Uzorak je činilo 70 studenata medicine koji su popunili odgovarajući upitnik, The Pittsburgh Sleep Quality Inventory (PSQI) i Beckovu skalu depresivnosti (BDI), kako bi se procenile životne navike i demografske karakteristike, kvalitet spavanja i simptomi depresivnosti.

Rezultati: Univarijantnom linearnom regresionom analizom pokazano je da su hronične bolesti, prisustvo stresa u poslednjih 12 meseci, trajanje sna, teškoće pri uspavljivanju, korišćenje lekova za spavanje i BDI skor bili značajni prediktori globalnog skora PSQI. Multivarijantna linearna regresiona analiza pokazala je da su hronične bolesti i depresija najznačajniji faktori koji utiču na kvalitet spavanja kod studenata.

Zaključci: Na kvalitet spavanja kod studenata u velikoj meri utiču hronične bolesti i simptomi depresivnosti, zbog čega je neophodno prevenirati i lečiti ove zdravstvene probleme.