Rozdiely v kvalite spánku medzi adolescentmi v regióne Banská Bystrica

Variations in Sleep Quality Among Adolescents in the Banská Bystrica Region

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Abstrakt
Cieľ. Identifikovať kvalitu spánku šestnásťročných adolescentov v Banskobystrickom regióne s dôrazom na intersexuálne rozdiely.
Materiál a metódy. Prieskum sa zameral na intersexuálne rozdiely v kvalite spánku adolescentov. Vzorka zahrňovala 447 študentov stredných odborných škôl a gymnázií z Banskobystrického regiónu. Na hodnotenie kvality spánku bol použitý štandardizovaný dotazník Pittsburghského indexu kvality spánku (PSQI). Dotazníky boli distribuované elektronicky prostredníctvom Google formulárov v období od apríla do júna 2023. Intersexuálne rozdiely boli analyzované percentuálne a štatisticky, s použitím χ^2 testu pri hladinách významnosti $p < 0,01$ a $p < 0,05$.
Výsledky. Signifikantné rozdiely ($p<0,01$, $p<0,05$) v intersexuálnych rozdieloch sme zaznamenali v čase zaspávania, vstávania, subjektívnom hodnotení kvality spánku, spánkovej latencii, efektivite a narušení spánku, ako aj v užívaní medikamentov. V dĺžke spánku, narušení koncentrácie, bdelosti a v celkovom skóre spánkových aktivít rozdiely neboli identifikované. Viac ako 50 % adolescentov vykazovalo poruchy spánku.
Závery. Intervencie zo strany školy, rodiny a médií by mali podporovať adolescentov v tvorbe zdravých spánkových návykov. Kľúčovými cieľmi sú optimalizácia času zaspávania a dĺžky spánku, vytvorenie prostredia podporujúceho kvalitný spánok a podpora dennej fyzickej aktivity.

Kľúčové slová: Adolescencia. Dotazník PSQI. Intersexuálne rozdiely. Rozsah a kvalita spánku.

Abstract
Objective: To identify the sleep quality of sixteen-year-old adolescents in the Banská Bystrica region, with a focus on gender differences.
Materials and Methods: The study focused on gender differences in adolescent sleep quality. The sample consisted of 447 students from secondary vocational schools and gymnasiums in the Banská Bystrica region. The Pittsburgh Sleep Quality Index (PSQI) was used to assess sleep quality. Data were collected electronically using Google Forms from April to June 2023. Gender differences were analyzed using percentage and statistical methods, specifically the χ^2 test, at significance levels of $p < 0.01$ and $p < 0.05$.
Results: Significant gender differences ($p < 0.01$, $p < 0.05$) were observed in sleep onset, wake-up times, subjective sleep quality, sleep latency, sleep efficiency, sleep disturbances, and medication use. No significant differences were found in sleep duration, concentration impairment, alertness, or overall sleep activity scores. More than 50% of adolescents exhibited sleep disturbances.
Conclusions: Interventions by schools, families, and the media should encourage adolescents to establish healthy sleep habits. The key objectives are to optimize sleep onset times and duration, create a sleep-supportive environment, and promote daytime physical activity.

Keywords: Adolescence. PSQI questionnaire. Gender differences. Sleep duration. Sleep quality.

Theoretical Background

Adolescence is one of the most vulnerable periods in human life, characterized by rapid and profound changes across all aspects of life, particularly the bio-psycho-social domains. These changes also impact sleep patterns. Variations in sleep-wake patterns during adolescence are primarily influenced by environmental, psychosocial, and biological factors, which form the basis of these shifts. Developmental changes in sleep and wake patterns through a two-process model, involving both circadian and homeostatic components [1]. Adolescents tend to go to bed later than before, resulting in a shortened sleep duration for many.

Recommended sleep duration for young adults aged 18 to 25 is between 7 and 9 hours [2], while some authors [3] suggest 8 to 10 hours for adolescents. This range is recommended for several reasons:

- Rapid growth and development: Adolescence is a period of intense physical and brain development, requiring sufficient rest for recovery. Insufficient sleep during in this period negatively affects brain functions, such as appetite regulation and energy balance [4]. Several studies [5-6] indicate that higher BMI values are associated with shorter sleep duration and vice versa.
- Physiological needs: Young individuals require adequate sleep to support both physical and emotional health. Sleep deprivation can hinder overall development.
- Cognitive functions: Quality sleep is essential for proper brain function, memory, and learning. Sleep deprivation can impair cognitive abilities and academic performance. Sleep quality significantly impacts emotions and cognitive functions, such as memory and learning capacity [7-8]. A lack of quality sleep in adolescents is linked to poorer academic performance and increased risky behaviors [9-11].
- Health consequences: Sleep deprivation in adolescents can cause metabolic changes associated with obesity and the development of diseases such as type 2 diabetes, hypertension, and depression [12-13]. No medication offers as many health benefits as quality sleep [14]. While sleep duration is crucial, the importance of sleep quality, characterized by uninterrupted sleep and a sense of refreshment upon waking [15].

Regarding sex differences, women's sleep needs and quality often change due to hormonal fluctuations, which may affect their daily functioning and work efficiency [16-17]. Although women generally experience better sleep quality than men, they are more likely to suffer from sleep problems [18]. Moreover, some studies [19-20] have shown differing relationships between BMI and sleep in men and women.

Objective

The objective is to identify the extent and quality of sleep among sixteen-year-old adolescents in the Banská Bystrica region, focusing on intersex differences.

Methodology

The research sample consisted of 447 students from vocational secondary schools (257) and gymnasiums (190) in the Banská Bystrica region, all aged 16. Of the sample, 266 were girls and 181 were boys. A detailed description of the research sample is presented in Table 1. Given the characteristics of the region, the sample can be considered representative, as the following standard criteria were met: the known total population size of students in vocational secondary schools and gymnasiums in the region by age (6,999), an estimated error (± 5%), a variance of 50%, and a confidence level of 95% (1 – α).

To assess sleep quality, we used the Pittsburgh Sleep Quality Index (PSQI) questionnaire [21]. The Slovak version of the questionnaire, distributed to students via Google Forms from April to June 2023 [22]. The questionnaire consisted of 19 questions assessing various aspects of sleep. Sleep quality was evaluated across seven domains: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction over the past month. The overall PSQI score ranges from 0 to 21, with higher scores indicating poorer sleep quality. Respondents with a total score greater than 5 are generally considered to have a sleep disorder [21].

Table 1 *Characteristics of the survey sample of students (n=447)*

Gender	***Type of high school attended***		
	Grammar School	**Vocational School**	**Total**
Girls	74	192	**266**
Boys	116	65	**181**
Total	**190**	**257**	**447**

Results

The survey results indicate that nearly a quarter of students fall asleep between 10:00 PM and 11:00 PM, while almost one-third fall asleep between 11:00 PM and midnight. A concerning finding is that 27.44% of girls and 19.34% of boys go to bed after midnight. Regarding wake-up times (Table 1), 51.88% of girls wake up before 6:00 AM, whereas nearly 50% of boys wake up between 6:00 AM and 6:30 AM. Overall, boys tend to wake up later than girls. The following evaluations directly relate to individual components of the PSQI questionnaire.

In terms of subjective sleep quality, nearly 50% of girls and 60% of boys rate their sleep as fairly good. Approximately one-third of students of both genders, with a slight majority among boys, rate their sleep as fairly poor. Further analysis of the questionnaire revealed that over 50% of students have very good sleep latency (0 Σ), typically falling asleep within 15 minutes without difficulty. The remaining 50% of students take more than 15 minutes to fall asleep or experience problems falling asleep within 30 minutes several times a month or week (Table 1; sleep latency Σ >0).

Table 2 *Bedtime, Wake-up Time, Sleep Quality and Sleep Latency research instrument (PSQI) of survey group (n = 447)*

		Girls	**Boys**	**Chi-square Test**
Bedtime	≤ 22:00	9,77 %	18,23%	0,025 (p) 9,294 ($x^2_{(3)}$)
	22:00 - 23:00	26,69%	29,28%	
	23:00 - 24:00	36,09%	33,15%	
	≥ 24:00	27,44%	19,34%	
Wake-up Time	≤ 6:00	51,88%	23,76%	8,438 E-14 (p) 63,943 ($x^2_{(3)}$)
	6:01 – 6:30	36,84%	48,07%	
	6:31 - 7:00	4,51%	25,41%	
	≥ 7:01	6,77%	2,76%	
Sleep Quality	Very good (0)	14,66%	3,31%	20,792 (p) 0,0001 ($x^2_{(3)}$)
	Fairly good (1)	49,62%	60,22%	
	Fairly bad (2)	28,57%	33,70%	
	Very bad (3)	7,14%	2,76%	
Sleep Latency	0 Σ (0)	53,01%	54,14%	3,697 E-07 (p) 32,715 ($x^2_{(3)}$)
	1 - 2 Σ (1)	6,02%	19,34%	
	3 - 4 Σ (2)	38,35%	19,89%	
	5 - 6 Σ (3)	2,63%	6,63%	

The third component assessed by the PSQI questionnaire is sleep duration (Table 2). Our findings show that the majority of male students (44.75%) and female students (41.73%) sleep between 6 and 7 hours per day. Additionally, 38.72% of females and 34.81% of males report sleeping more than 7 hours daily. A concerning finding is that nearly 20% of both male and female students sleep less than 6 hours per day.

Table 3 *Sleep duration, Sleep efficiency, Sleep disturbance, Sleep medication, Daytime dysfunction and Global Score PSQI of survey group (n = 447)*

		Girls	Boys	Chi-square Test
Sleep Duration	≥ 7 hours (0)	38,72%	34,81%	0,0860 (p) 6,592 ($x^2_{(3)}$)
	6 - 7 hours (1)	41,73%	44,75%	
	5 - 6 hours (2)	16,92%	13,26%	
	≤ 5 hours (3)	2,63%	7,18%	
Sleep Efficiency	≥ 85% (0)	98,50%	79,01%	1,657 E-10 (p) 48,511 ($x^2_{(3)}$)
	85% - 75% (1)	0,75%	8,84%	
	75% - 65% (2)	0,75%	7,18%	
	≤ 65% (3)	0,00%	4,97%	
Sleep Disturbance	0 Σ (0)	0,00%	6,63%	8,548 E-08 (p) 35,728 ($x^2_{(3)}$)
	1 - 9 Σ (1)	70,68%	81,77%	
	10 - 18 Σ (2)	23,31%	7,73%	
	19 - 27 Σ (3)	6,02%	3,87%	
Sleep Medication	0/ month (0)	90.60%	96,13%	0,025 (p) 9,305 ($x^2_{(3)}$)
	< 1/ week (1)	4,51%	3,87%	
	1 - 2/ week (2)	2,63%	0,00%	
	> 3/ week (3)	2,26%	0,00%	
Daytime Dysfunction	0 Σ (0)	4,89%	10,50%	0,067 (p) 7,158 ($x^2_{(3)}$)
	1 - 2 Σ (1)	48,50%	39,78%	
	3 - 4 Σ (2)	29,70%	33,70%	
	5 - 6 Σ (3)	16,92%	16,02%	
Global Score	> 5	56,39%	53,59%	0,558 (p) 0,341 ($x^2_{(2)}$)
	≤ 5	43,61%	46,41%	

The fourth component of the PSQI questionnaire assesses sleep efficiency, defined as the actual time spent sleeping relative to the time spent in bed. Our findings show that girls demonstrated higher sleep efficiency, with 98.5% achieving efficiency levels above 85%. In comparison, 79.01% of boys showed sleep efficiency higher than 85%. The fifth component of the PSQI evaluates sleep disturbances (Table 2) based on several influencing factors (lower scores indicate fewer problems and disruptions). Recalculated scores reveal that boys experience fewer disturbances affecting sleep quality than girls.

Regarding the use of sleep medication (component 6), 90% of girls and 96% of boys do not use any medication. On average, 4.2% of both genders reported using sleep medication less than once a week, while approximately 5% of girls use sleep aids at least once a week.

The final component of the PSQI examines daytime dysfunction, which refers to how sleep issues impact daily functioning and mood. We found no significant differences between boys and girls in this regard. Overall, in the PSQI evaluation, 43.61% of girls and 46.41% of boys reported good sleep quality (Table 2).

Discussion

Each individual, particularly children, needs to establish a regular sleep rhythm [23]. Once this routine of consistent sleep and wake times is formed, the body will "automatically" anticipate the next step, resulting in a positive internal alignment. Our findings show that nearly 35% of the adolescents in our study fall asleep after 11 PM, and around 25% fall asleep after midnight. Students who go to bed late often engage in activities that bring them pleasure, such as consuming high-energy, unhealthy foods and drinking energy drinks to fight fatigue in the afternoon and evening [24]. Maintaining a regular sleep schedule is associated with better sleep quality, a lower risk of insomnia, and improved overall health, as it helps synchronize the body's internal clock [25].

15% of college students suffer from poor sleep quality, with 12-13% reporting problems with falling asleep, frequent nighttime awakenings, or waking up too early at least three times a week [26]. Additionally, 30.43% of respondents reported waking up 1-2 times per week. Regarding sleep duration, only one-third of students from both genders sleep more than seven hours, indicating a prevalent sleep deficit even at a young age. Only 27.3% of students met the American Academy of Sleep Medicine's (AASM) recommended sleep duration, with boys achieving this more often than girls by a margin of over 5% [27].

The "Health Behaviour in School-aged Children" (HBSC) study conducted in Slovakia in 2022 on a sample of 10,000 students aged 11, 13, and 15 shows a decline in the number of students sleeping 8+ hours on school days since 2014, particularly among older girls [24]. Less than half of the students sleep the recommended 8-9 hours, and 20% of adolescents reported sleeping less than six hours, which we consider a negative trend.

A significant increase in depression, mood changes, and "lack of energy" among adolescents with five hours of sleep [28]. Short-term sleep deficits are associated with physiological symptoms such as headaches, hand tremors, increased blood pressure, and elevated stress hormones [29]. Concentration and learning difficulties may arise [30]. The importance of sleep regularity, recommending going to bed and waking up at the same time daily [31]. Regular sleep patterns reduce sleep onset time and improve waking and daytime alertness.

We observed significant intersex differences in sleep latency, with nearly 40% of girls taking 31-60 minutes to fall asleep, compared to boys, with findings significant at $p<0.01$. In the 6-17 age group, falling asleep should take no more than 30 minutes, with a maximum of one awakening per night lasting no longer than five minutes, and at least 85% of time in bed should be spent sleeping [24]. The optimal sleep onset time is within 30 minutes, which is achieved by only half of the adolescents in our study [32].

Modern technology and blue light emissions have a major impact on sleep latency [33]. The study compared the effects of reading traditional paper books versus e-books with blue light exposure for four hours before bedtime over five consecutive days. Participants who chose e-books experienced a 55% decrease in melatonin levels and a 90-minute delay in its production, as well as a 10-minute increase in sleep onset time. Limiting exposure to blue light before sleep, as devices such as monitors, smartphones, tablets, TV screens, and LED lighting emit stimulating blue light [34-35].

Our findings show that nearly 93% of students do not use sleep medications, which is a positive outcome. Similar results were observed [36] on university students, where 87.8% did not use sleep medication. 4.81% of respondents used prescription sleep medications, and 2.02% used over-the-counter sleep aids [37]. More than 90% of the students in our study experienced some form of daytime dysfunction [24]. 11% of Slovak adolescents admitted to falling asleep in class. Daytime sleepiness is commonly reported among adolescents [38], likely due to their average of seven hours of sleep during the week, indicating elements of sleep deprivation. 20-30% of children experience sleep disturbances [38]. There is a breakdown of PSQI scores for quantifying sleep disturbances: a total score of ≤ 5 indicates good sleep quality, 6-10 suggests poor sleep quality, and ≥ 10 signifies severe sleep disturbances [39]. Based on this scale, 12% of both male and female students (12.03% of girls and 11.05% of boys) exhibit severe sleep disturbances.

Results

The results of the survey indicate that the sleep habits of boys and girls in the Central Slovak region vary significantly in several key areas:

- Bedtime: Nearly 50% of boys fall asleep before 11 PM, whereas only 37% of girls do. Additionally, 27% of girls go to bed after midnight ($p<0.05$).
- Wake-up Time: Significant differences in wake-up times were observed between boys and girls ($p<0.01$), with 51% of girls waking up before 6 AM.
- Subjective Sleep Quality: Most respondents rated their sleep as generally good, with boys reporting higher positive ratings ($p<0.01$).
- Time to Fall Asleep: More than half of the students fall asleep within 15 minutes. However, nearly 40% of girls take between 30 and 60 minutes to fall asleep ($p<0.01$).
- Sleep Efficiency: Girls demonstrated higher sleep efficiency ($p<0.01$), though they also reported more frequent sleep disturbances ($p<0.01$).
- Medication Use: Significant gender differences were found in the use of sleep medications ($p<0.05$), with girls using them more frequently.

Despite these differences, total PSQI scores did not show significant variations between genders. Over 50% of students reported sleep disturbances, with 12% displaying serious sleep disorders, which require attention from schools or regional public health authorities. Early diagnosis and treatment of sleep disorders are essential due to their high prevalence and potential health impacts [32]. Interventions should focus on establishing optimal bedtimes, ensuring adequate sleep duration (with nearly 20% of students sleeping less than 6 hours per night), creating sleep-friendly environments, and providing support for students struggling with sleep issues. These measures would not only improve sleep quality but also contribute to better overall health and academic performance.

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