

RESEARCH ARTICLE

Sleep duration and its relationship with school performance in Iranian adolescents

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Keywords

Sleep duration • School performance • Adolescents

Summary

Background. *Inadequate or poor sleep quality is common problems in adolescent that affect on their learning, memory and school performance. The present study aimed to determine the association between sleep hours and academic performance in young adults.*

Methods. *This cross-sectional study was designed as a descriptive-analytic study. Samples of adolescents of 14-18 years old in Qazvin city were enrolled. The Pediatric sleep questionnaire and BEARS questionnaire used for all students to screen comprehensively major sleeps problems in them. Chi-square test, t-test, analysis of variance (ANOVA), and correlation were performed to determine the relationship between the data ($P < 0.001$).*

Results. *Between 653 adolescents, 40% were male and 60% were female. Sleep duration, sleep onset delay, sleep insufficient, rate*

of oversleeping and academic performance had a direct relationship with gender ($P < 0.001$). The sleep duration, rate of oversleeping and academic performance were significantly higher in boys, sleep onset delay and sleep insufficient was significantly higher in girls. Time of falling sleep at weekend nights and week-day nights have positively correlation with age ($P < 0.001$). Also, a significant relationship between students' sleep hours with academic performance was shown ($P < 0.001$).

Conclusions. *The overall result was that sleep duration, sleep onset delay, sleep insufficient and rate of oversleeping of students in this study had a significant influence on academic performance. Students without difficulty in falling asleep had good academic performance in compared to students with difficulty in falling asleep.*

Introduction

Sleep is a periodic and natural state of human which during that body and mind is at rest, the eyes usually close and consciousness is partially or completely reduced [1]. Body movements reduce during sleep and body does not respond to external stimuli. Almost a third of humans' life is spent in sleep [2, 3]. Sleep is a biological behavior of human that regulation of it is based on a complex biological pattern in the brain. In most cases, disruption of the sleep cycle is an early sign of physical and mental illnesses [4]. Good quality of sleep is necessary to perform routine daily function including metabolic activities, hormonal processes, and proper regulation of appetite [5, 6]. Chronic sleep deprivation induces many detrimental effects of physical health including impaired carbohydrate metabolism, increase risk of diabetes, and dysfunction of appetite regulation hormones such as leptin and ghrelin. In some documents suggested that development of obesity and diabetes in elder people is due to poor quality of sleep in this group [7]. It is important that inadequate sleep (insufficient quantity or poor quality of sleep) is epidemic in our

modern societies, and many people suffer from it [8-10]. Empirical evidence has shown that children need an average of 9 hours of sleep at night. According to the researches, 45% of them sleep less than 8 hours at night [10, 11]. Sleep problems affect the academic performance of students [12-14]. Obtaining adequate sleep is essential for good performance of children in school. Inadequate or poor sleep qualities are common problems in adolescent that effect on their learning, memory and school performance [12]. Other studies have shown that insufficient sleep, fragmentation of sleep and sleeping late have detrimental effects of academic performance of teenagers [13-15]. In a study in America, which was performed between 88 students, it was proved that better quality, longer duration, and greater consistency of sleep were correlated with the better grades in the lessons [16]. In a research in Pakistan, 64.24% of students with global Pittsburgh sleep quality index (PSQI) score ≥ 5 have poor sleep quality. The mean grade point average (GPA) of poor sleepers was 2.92 ± 1.09 which was significantly lower than that of good sleepers. Poor sleep quality had a negative impact on the academic performance and adequate sleep had a positive impact on the refresh

of students every day; adequate sleep helps them in learning and memory processing [5]. In Iran, study of 407 students found that 9.1, 36.1, 39.3 and 13.5% of them had excellent, good, satisfactory and poor daily sleep quality. In this research, appropriate sleep duration and adequate sleep period had a positive effect on the academic performance including educational achievement, high scores in the exams and freshness in the classroom [17]. Given the importance of sleep for students, the present study aimed to determine the association between sleep hours and academic performance in young adults.

Materials and methods

STUDY DESIGN

This cross-sectional study was designed as a descriptive-analytic study. A sample of adolescents of 14-17 years of age in the first, second and third degree of high school (two schools were chosen, randomly) in Qazvin city were enrolled. Sample size was calculated with considering 8% precision, 95% confidence interval and 80% power about 700 students. Participants were selected using cluster sampling, so that 700 students were chosen from 10 schools in 5 different parts of city (two schools were selected from each area of city). Pre-university students were excluded from study because of the stress due to university entrance exam and its effects on sleep pattern. After selecting the desired school, some students were selected randomly from them.

STUDY TOOL

Study's questionnaires were distributed among them. Data collection tools were two questionnaires which their validity and reliability has been confirmed in previous studies. The Pediatric Sleep Questionnaire consist 22 questions was designed to evaluate sleep problems in children. Its sensitivity and specificity have a range between 0.81 to 0.85, and 0.87, respectively compared to polysomnographic results. Also, Cronbach's alpha coefficient of questionnaire was 0.77 in this study for PSQ. Also, the BEARS questionnaire developed by Owen used for all students to screen comprehensively major sleeps problems in them. Five sleep domain evaluated by this questionnaire including bedtime problems, excessive daytime sleepiness, awakening during the night, regularity and duration of sleep, and snoring. Previously, Mohammadi and colleague were assessed validity and reliability of Persian version of this questionnaire. The BEARS internal consistency in our study was high with a Cronbach's alpha of 0.79. A total of 700 questionnaires were distributed. Twenty of questionnaires were excluded because of the incomplete filling of the questions. Also, 27 of students were excluded due to suffering from diseases that effect on their sleep parameters [18-21].

STATISTICAL ANALYSIS

Finally, data collected from 653 cases were confirmed for use in the analysis. Statistical package for social sciences (SPSS) version 16 was used for data analysis. Chi-square test, t-test, analysis of variance (ANOVA), and correlation were performed to determine the relationship between the data ($P < 0.001$).

Results

In this study, 653 adolescents 14-18 years were surveyed, of which 261 (40%) were male and 392 (60%) were female. Average age of our sample was 15.7 ± 0.9 . Education levels in students were as follow: 154 (23.6%) in the first year, 242 (37.1%) in the second year of high school and 257 (39.4%) in the third year of high school. Information on age, education grade, hours of sleep during the night, and delay amount in the sleep onset are mentioned (Tab. I). The average sleep duration was significantly higher in boys than girls ($P < 0.001$). The hours of starting sleep at night and waking in the morning was significantly different between boys and girls ($P < 0.05$). Sleep onset delay was significantly higher in girls than boys ($P < 0.001$).

Hours of sleep on weekdays and weekends between boys and girls were compared (Tab. II). Sleep duration was classified in three different categories (less than 7 hours, 7-9 hours, and more than 9 hours during night). Sleep insufficient was significantly higher in girls than boys ($P < 0.001$). In contrast, the rate of oversleeping was higher in boys. Also, hours of sleep on weekends were higher than weekdays. Pearson analysis showed that time of falling sleep at weekend nights ($\rho = 0.83$, $P = 0.03$) and weekday nights ($\rho = 0.14$, $P < 0.001$) have positively correlation with age.

Academic performance of students was divided into three categories based on their GPA. Students with GPA equal or less than 15 was classified in poor academic performance. Also, students with GPA between 15.01-17.99 and equal or more than 18 were classified as medium and good academic performance, respectively. Results showed that academic performance was significantly better in girls than boys (Tab. III).

Students who sufferings from difficulty to falling asleep have significantly lower academic performance ($P < 0.001$) (Tab. IV). Also, there was a significant relationship between students' sleep hours in weekends and weekdays with academic performance. The average hours of sleep among students with better academic performance was less than students with medium and poor academic performance ($P < 0.001$). The amount of delay in falling asleep was more in students who had lower academic performance ($P = 0.002$) and total sleep time during weekend ($P < 0.001$) and weekdays ($P < 0.001$) were significantly higher in students with better academic performance (Tab. V).

Tab. I. The baseline characteristics and sleep-wake schedule in male and female students.

Baseline characteristics	Girls	Boys	Total	P-value
	Mean ± SD	Mean ± SD	Mean ± SD	
Age	15.76 (1.00)	15.70 (0.97)	15.73 (0.99)	0.44
GPA	17.09 (1.63)	16.64 (1.85)	16.91 (1.73)	0.001
Hours of falling asleep at night during weekend	24.88 (1.16)	24.54 (1.25)	24.75 (1.21)	< 0.001
Hours of falling asleep at night during weekdays	24.00 (0.95)	23.73 (0.97)	23.89 (0.97)	< 0.001
Hours of waking up at morning during weekend	9.60 (1.71)	9.35 (1.32)	9.50 (1.57)	0.038
Hours of waking up at morning during weekdays	6.31 (0.60)	6.70 (0.34)	6.46 (0.55)	< 0.001
Total sleep time during weekend	10.29 (1.89)	10.60 (1.75)	10.42 (1.84)	0.034
Total sleep time during weekdays	8.17 (1.68)	8.79 (1.46)	8.42 (1.62)	< 0.001
Latency to falling asleep (min)	41.44 (40.87)	29.75 (26.22)	36.77 (36.17)	< 0.001

Tab. II. Frequency of male and female students in terms of sleep duration on weekends and weekdays.

Sleep duration	Gender	Less than 7 hours Number (percent)	7-9 hours Number (percent)	More than 9 hours Number (percent)	P-value
Total sleep duration on weekends	Boys	6 (2.3)	165 (63.2)	90 (34.5)	< 0.001
	Girls	60 (15.3)	246 (62.8)	86 (21.9)	
	Total	66 (10.1)	411 (62.9)	176 (27)	
Total sleep duration on weekdays	Boys	4 (1.5)	46 (17.6)	211 (80.8)	< 0.007
	Girls	12 (3.1)	106 (27)	274 (69.9)	
	Total	16 (2.5)	152 (23.3)	485 (74.3)	

Tab. III. Comparison academic performance and difficulty in falling asleep in male and female students.

Variables	Boys Number (percent)	Girls Number (percent)	Total Number (percent)	P-value
Academic performance				0.03
Good (≥ 18)	76 (29.1)	138 (35.2)	214 (32.8)	
Medium (15.01-17.99)	124 (47.5)	193 (49.2)	317 (48.5)	
Poor (≤ 15)	61 (23.4)	61 (15.6)	122 (18.7)	
Difficulty in falling asleep				0.13
	Boys Number (percent)	Girls Number (percent)	Total Number (percent)	
Yes	61 (23.4)	108 (27.6)	169 (25.9)	
No	200 (76.6)	284 (72.4)	484 (74.1)	

Tab. IV. Relationship between difficulty in falling asleep and academic performance.

Academic performance	Difficulty in falling asleep		P-value
	Yes	No	
	Number (percent)	Number (percent)	
Good (≥ 18)	30 (14)	184 (86)	< 0.001
Moderate (15.01-17.99)	99 (31.2)	218 (68.8)	
Poor (≤ 15)	40 (32.8)	82 (67.2)	

Tab. V. Relationship between total sleep-wake schedule, and delay to falling asleep with students' academic performance

Sleep-wake schedule	(years ≤ 15) N = 122 Mean ± SD*	(years 15.01-17.99) N = 317 Mean ± SD	(years ≥ 18) N = 214 Mean ± SD	P-value
Hours of falling asleep at night during weekend	25.17 (1.37)	25.10 (1.38)	25.20 (1.45)	0.69
Hours of falling asleep at night during weekdays	23.66 (1.13)	23.57 (1.21)	23.86 (1.12)	0.02
Hours of waking up at morning during weekend	10.50 (1.77)	10.43 (1.61)	10.12 (1.62)	0.055
Hours of waking up at morning during weekdays	6.68 (0.57)	6.57 (0.64)	6.52 (0.55)	0.083
Total sleep time during weekend	10.86 (2.01)	10.54 (1.79)	9.97 (1.72)	< 0.001
Total sleep time during weekdays	8.91 (1.65)	8.44 (1.68)	8.11 (1.45)	< 0.001
Latency to falling asleep (min)	41.75 (41.30)	39.55 (36.51)	29.80 (31.38)	0.002

Mean ± SD*; mean ± standard deviation (SD).

Discussion

In this study, the mean total sleep duration was 42.8 hours during weekdays, and this amount was significantly lower in girls than boys. Also, a significant difference found between boys and girls in terms of the time to go to bed and waking up in the morning. Another result showed that the average number of sleep hours was lower in students who had better academic performance than students with average and poor academic performance. According to the center for disease control and prevention (CDC) in America, the optimal duration of sleep recommended for teenagers are more than 8.5 hours at night [19]. In our sample, duration of sleep for 24 hours was 8.42 ± 1.6 and 10.4 ± 1.8 for weekdays and weekends, respectively. Total duration of sleep was more in boys than girls, and girls went later to sleep than boys at both of the weekends and weekdays. In a study in America the average length of sleep on the weekend was about 9 hours in boys and girls. But, this amount was reduced to 7.1 hours for boys and 5.2 hours for girls during weekdays. These results were different from current study that in our study students' sleep duration on weekend was 5.1 hours more than American teenagers. Also, the duration of sleep in weekdays was lower for both American girls and boys about 2.1 and 1.8 hours, respectively. So, in total during the whole week, Iranian teenagers slept more than American teenagers. In this study, there was not significant correlation between age and sleep duration. Total sleep duration decreases with increasing age [19]. In another study in Canada, it was found that seventy percent of students aged 14 to 18 years old sleep less than 8.5 hours during the night [10]. In this study, sixty percent of students reported that they sleep less than 8.5 hours during night at weekdays. Also, we found a wide gap in sleep duration between weekends and weekdays (Yo-yo sleeping), so that our samples slept two hours more in weekends compared to weekdays. These results show that students' sleep was not enough during weekdays, therefore they sleep more in weekends to compensate their sleep insufficiency. This large difference will cause a negative impact on students' performance in school [20]. This amounts in studies conducted in other countries is as follow: America 2.1 hours [19], Taiwan 1 hour [21], China 2.5 hours [22], and Australia 16 minutes [20]. There was no difference in sleep duration between weekdays and weekend in Switzerland [23]. Current study showed that with increasing students' age, the time for going to bed were delayed. Similar results were obtained in other studies to confirm our results [21, 24]. In this study, total sleep duration was more in boys than girls in all days of the week. Similar results were obtained in a study conducted in Taiwan [21], but a survey in Australia showed that teenager girls sleep more than boys [20]. Recent findings have shown that sleep is important for the proper function of learning and memory [13, 25]. The possibility of delay in sleep onset increases with the onset of puberty that can lead to daytime sleepiness and negative effects on academic performance in students.

A study in America showed that delay in sleep initiation more than 30 minutes for more than one night during the week has a significant association with increased rates of academic failure in students [26]. In another study conducted in China, the average delay in starting sleep was 30 minutes in students [27]. This amount was calculated in the present study 36.77 minutes. A review study in 2010 showed that increasing hours of sleep is associated with better academic performance in students [12]. But in our study, students who have fewer hours of sleep during night had better academic performance. On the other hand, another study did not report a significant relationship between sleep duration and academic performance in students [28]. In a study in Iran, 102 students completed PSQI. Based on the results there was no significant difference between students with high grades and those with low grades. But there were moderate and sometimes severe sleep disturbances in both groups. Also, there was no significant difference between sleep quality and academic achievement [29]. In another hand, in our results significant difference between sleep quality and academic performances between students was existed. A research between 341 selected students in Iran showed that 59.1% of them had poor sleep quality. Also, there was a significant negative relationship between sleep quality with academic interaction and academic vitality. There was a significant positive relationship between academic motivations with academic vitality. Also, a significant difference between male and female students in academic vitality was observed [30]. Different reasons such as level of family income, family size, intake of supplements and vitamins, social media dependency, addiction to social networks and social issues can affect the academic success in the different students [29, 31]. Improve adolescent sleep including delaying school start times, providing sleep education, and utilizing light therapy to improve the health, wellbeing and academic performance of sleepy teenagers are in the programs of researchers in this field in different countries [30]. The results from this study indicated that sleeping time in Iranian students is more than students in other countries. In this study, sleep duration, sleep onset delay, sleep insufficient and rate of oversleeping was associated with better academic performance in students. Also, difficulty in falling asleep was associated with weaker academic performance. The overall result was that in students without difficulty in falling asleep, a positive influence on the academic performance was observed.

Conclusions

The result of this study showed that some of sleep characteristics such as sleep duration, sleep onset delay, sleep insufficient and rate of oversleeping of students could be a significant influence on adolescents' academic performance. Further studies are needed to objectively determine the effect of sleep variables on adolescents' performance.

LIMITATIONS

First, the design is cross sectional. Therefore, it may be difficult to confirm a cause-effect relationship. Moreover, the selected students were found randomly. Also, findings may not be applicable to all students in other geographical locations.

Ethical statement

All recruiters agreed. Participation in the study was voluntary and participants were told that they could withdraw from the study at any time. The information obtained from the participants in this study has been kept confidential. Also, the participants were not exposed to any kind of injury. The study was approved by the Ethics Committee of the Qazvin University of Medical Sciences. Thesis code: 952

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Conflicts of interest statement

The authors declare no conflict of interest.

Authors' contributions

All authors had same share in collecting data for the study, contributing to the study design and sampling methodology, analyzed the data and presented its findings. All authors read and approved the last version.

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