Understanding sleep habits and associated factors can help to improve sleep in high school adolescents

Kutluhan Yılmaz[1], Ayşe Kılınçaslan[2], Neriman Aydın[3], Seval Kul[4]

Departments of [1]Pediatrics, [2]Child and Adolescent Psychiatry, [3]Public Health, and [4]Biostatistics, Gaziantep University Faculty of Medicine, Gaziantep, Turkey

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We aimed to describe the sleep profiles and associated factors of poor sleep in adolescents. We gave a sleep questionnaire and Strengths and Difficulties Questionnaire to 3,441 high school adolescents (15-18 years) in Gaziantep, Turkey. Adolescents reported a requirement of 10.4 hours of sleep on average to feel their best during the day. However, total night sleep time (TNST) was 7.42±1.48 hours on school nights and 9.40±1.37 on non-school nights. TNST of ≥9 hours on both school nights and non-school nights was detected in 8.2%. Average bedtime and wake-up time were 23:16 and 06:41 on school nights. Bedtime was approximately 30 minutes later on non-school nights. The shift in wake-up time was nearly 2.5 hours. Statistical analysis by logistic regression model showed that TNST was most significantly correlated with school start time (morning versus afternoon) irrespective of school or non-school nights. TNST on school nights was negatively correlated with age, passive smoking at home, drinking tea/coffee, and conduct problem, whereas TNST on non-school nights was negatively correlated with the mother's education, male gender, body mass index, number of household members, and having a television in the bedroom. Daytime napping (21.3%) was associated with morning start time, age, female gender, and mother's education. Sleep-onset insomnia with sleep latency >30 minutes (21%) was not related to age or gender; however, it was associated with abnormal breathing during sleep. The findings revealed that inadequate sleep is quite prevalent among high school adolescents. Given the fact that most of the associated factors are modifiable, inadequate sleep is not inevitable for adolescents.

Key words: sleep, adolescent, insomnia.

Optimal sleep is essential for mental and physical health. However, many adolescents suffer from several problems related to insufficient or poor sleep, from poor cognitive and behavioral performance to obesity and life-threatening accidents[1-4]. Therefore, recognition and treatment of sleep problems are essential to improve adolescent health, productivity and safety. For instance, the negative effect of an early start time for school on sleep in adolescents was revealed by studies previously[5,6]. A delayed school start time yielded significant improvement in attendance rates, less sleeping in class and less student-reported depression[7]. Delaying the school start time was also proposed for decreasing motor vehicle crashes among adolescent drivers[8]. The pathogenesis of poor sleep in adolescents includes several other factors in addition to the start time, from intrinsic biological factors related to physiological and psychological features of adolescence to several extrinsic effects arising from environmental and sociocultural conditions[6,9-13]. The present study is the first comprehensive study of Turkish adolescents that looks at associated factors contributing to poor sleep in adolescents. Our purpose is to better understand the sleep profiles and sleep-related problems in adolescents and hence to facilitate the development of preventive approaches.

Material and Methods

Study Sample and Procedure: After obtaining the approval of the Education Bureau and Governorship of Gaziantep and the local ethics committee of Gaziantep University, a cross-sectional study was carried out among a sample of high school students in Gaziantep, Turkey, between May-June 2008. Of 60 high schools in Gaziantep with 53,921 students, nine high schools with a total of 3,780 students were randomly selected according to cluster sampling technique. Two meetings were held with school counselors in order to give information about sleep-related problems and the aim and protocol of our study. Questionnaires were distributed and explained to the students by the counselors. The students were asked to complete the questionnaire along with their parents only if their parents signed the informed consent form. All the students were requested to return the questionnaires to the counselors within one week.

Questionnaire: The questionnaire included questions covering four main areas: (1) Regarding sociodemographic data, the student's age, gender, height, weight, and number of household members were required on the form. Parental education (less than 5 years of primary school education, primary school, high school or university) and passive smoking at home (Y/N) were additionally questioned. (2) For determining total night sleep time (TNST) and sleep latency, students were requested to indicate their bedtime, sleep latency and wake-up time on both school-days and non-school days with no scheduled activity. They were also asked to write their ideal night sleep time (sleep duration to feel their best during the day). In addition, sleep-related habits (any habit to facilitate falling asleep, awakening in the mornings spontaneously or with help, such as by the parent or with an alarm) and regular daytime napping (at least a few days per week) were queried. (3) Abnormal sleep hygiene practice (drinking tea or coffee at least 3 evenings a week, television in the bedroom, sharing the bed with someone else, sharing the bedroom with someone else) and abnormal breathing during sleep (habitual snoring, witnessed apnea, awakening with gasping) were questioned. (4) Questions concerning academic performance (poor, average, good or very good performance at school) and emotional/behavioral performance in four areas (emotional symptoms, conduct problems, hyperactivity/inattention and prosocial behavior) were also included. Emotional/behavioral performance was sought using the Turkish version of the Strengths and Difficulties Questionnaire (SDQ)[14,15]. The SDQ is a brief screening

Table I. Sleep Profiles Among High School Adolescents in the Study (n: 3441)

	Study Sample	School start time*		
		Morning	Afternoon	
Bedtime				
• School nights	22:51±0.51	22:47±0.52	23:13±0.56	
• Non-school nights	23:22±0.48	23:21±0.48	23:23±0.48	
Sleep latency >30 min				
• School nights	20.5%	18.7%	26.5%	
• Non-school nights	21.5%	19.7%	26.9%	
Wake-up time				
• School nights	06:41±1.29	06:16±0.32	07:25±1.25	
• Non-school nights	09:11±1.23	09:06±1.25	09:17±1.21	
TNST (hours)				
• School nights	7.42±1.48	7.09±1.08	7.98±1.82	p<0.001
• Non-school nights	9.40±1.37	9.35±1.39	9.51±1.43	p<0.001
Ideal night sleep time	10.40±1.79	10.29±1.74	10.61±1.73	p<0.001
Awakening with help in the a.m.	58.1%	71.1%	27%	p<0.001
Regular daytime napping	21.3%	28.4%	8.1%	p<0.001
Habits to facilitate falling asleep	22.2%	22.1%	22.8%	p=0.67

TNST: Total night sleep time.

*adjusted for age and gender (p values for the comparisons between morning versus afternoon start time).

questionnaire for mental health problems in children, which is widely used for research purposes and validated in terms of its ability to distinguish between clinical and community samples. It can be completed by parents, teachers or children. In our study, the self-report form was used.

The participants with habitual snoring, witnessed apnea or awakening with gasping were accepted to have abnormal breathing during sleep. Weekend nights with no scheduled daytime activity such as extracurricular courses were referred to as non-school nights. TNST was calculated from bedtime, sleep latency and wake-up time; body mass index (BMI) (kg/m^2) was calculated from height and weight. Sleep latency longer than 30 minutes were designated as prolonged sleep latency or sleep-onset insomnia[13].

***Data Analysis*:** After the evaluation of descriptive data on sleep patterns with regard to school start times (Table I), data were analyzed statistically in two steps. In the first step, chi-square or Student-t test was performed in order to detect pair associations of each dependent variable, that is, prolonged sleep latency, TNST and regular daytime napping. In addition, partial eta-squared and phi coefficient values were calculated for effect size[16]. After determining the pair associations of which p values were less than 0.1 through the statistical analyses of Step 1, we performed statistical tests of the logistic regression model (enter mode) in order to reveal which of these pair associations were independently associated with TNST, prolonged sleep latency or regular daytime napping (Step 2 tests). Cohen's effect size values were also calculated.[17] P values <0.05 were accepted as significant for the final conclusions. All statistical tests were carried out using SPSS v 13.0.

Results

Of 3,780 questionnaires, 34 could not be given due to student absence during the study week, and 242 did not respond due to lack of parental consent or student compliance. There was no difference between non-responders and responders regarding gender, age, schools, and grades. Of all the questionnaires, 91% was fully completed by the students (n: 3441; 16.17±0.95 years of age; 51.2% female).

Body mass index (BMI) was 20.71±2.72 kg/m^2. Passive smoking at home, drinking tea or coffee at least 3 or more nights per week and television in the bedroom were noted in 59.7%, 52.6% and 46.5% of the adolescents, respectively. Of the participants, 74.6% were sharing their bedroom and 9.4% were sharing their bed. The number of household members at home was 5.37±1.8. A father or mother with school education level of <5 years was detected in 8.4% and 12.1%, respectively. Sleep latency on school nights or non-school nights was >30 minutes in 20.5% and 21.5%, respectively. Abnormal breathing during sleep was described in 7.7%. Emotional symptoms, conduct problems, hyperactivity/inattention symptoms, and prosocial skills were detected in 13.7%, 10.7%, 14.5%, and 4.4% of the participants, respectively. Poor school performance was reported by 4.7%.

School start time was morning (07:00-08:00 am) for 2,237 students (65%) and afternoon (12:00-12:40 pm) for the remaining. Descriptive data regarding sleep profiles of the adolescents in our study are given in Tables I and II. Table III presents both independently associated variables and the other variables that were tested in Step 2 tests. Considering the variables related to TNST, we exemplify TNSTs in some extreme conditions observed in our study sample (Table IV). In addition, effect size

Table II. Distributions of Participants with Regard to their Total Night Sleep Times (TNSTs)

TNST <9 hours (<6 hours) on school nights	88.1% (16.5%)
* In those with morning start time	* 97.1%
* In those with afternoon start time	* 71.5%
TNST <9 hours in adolescents going to bed before 21:00 on school nights	38.0%
* In those with morning start time	* 47.0%
* In those with afternoon start time	* 21.2%
TNST <9 hours on non-school nights	38.1%
TNST ≥9 hours on both school nights and non-school nights	8.2%

values calculated for the pair associations of TNST, prolonged sleep latency or regular daytime napping were detected to be small except the medium effect size of the relation between morning start time and TNST on school nights (eta-squared: 0.11). R squares in logistic regression analyses were between 0.07 and 0.63.

Discussion

The most prominent change in sleep during adolescence is in bedtime and wake-up time, with a strong trend for later for both[18,19]. Adolescents want to go to bed near midnight. However, most adolescents must wake up early in the morning to prepare for school. Therefore, most adolescents get approximately 7 hours of sleep on school nights whereas they require 9.2 hours of sleep[18-21]. On weekends, they usually go to bed later compared to weeknights[18]. On weekend mornings, they want to wake up much later to overcome their sleep deficit. As the shift is more remarkable in wake-up time than bedtime (3-4 vs 1-2 hours), they sleep approximately 2 hours longer on weekends[20]. Nevertheless, a considerable number of adolescents still sleep less than they need. For example, in the Sleep in America poll 2006[22], the ratio of high school adolescents sleeping less than 9 hours was 87% on school nights and 41% on non-school nights. In our study, we found that the adolescents slept 7.42 hours on average on school nights (Table I). On non-school days, as wake-up time shifted about 2.5 hours, mean sleep duration was 9.4 hours. Despite that, one- third of our adolescents still slept less than 9 hours on non-school nights. Moreover, only 8.2% reported sleeping 9 hours

Table III. Statistical Relations (p) by Binary Logistic Regression or Linear Regression Models (Step 2 Tests)

	Sleep-onset insomnia on school nights	Sleep-onset insomnia on non-school nights	TNST on school nights	TNST on non-school nights	Daytime Napping
Negative relation	• Morning start time (<0.001) • TNST on school nights (<0.001)	• Morning start time (<0.001) • TNST on school nights (<0.001) • TNST on non-school nights (<0.001)	• Morning start time (<0.001) • Age (<0.001) • Tea or coffee (<0.001) • Sleep latency >30 mins on school nights (<0.001) • Passive smoking (0.004) • Conduct problem (0.021)	• Morning start time (<0.001) • Mother's education <5 years (<0.001) • Sleep latency >30 mins on non-school nights (<0.001) • Household members (0.002) • BMI (0.001) • TV in bedroom (0.041)	
Positive relation	• Sleep initiation habits (<0.001) • Sleep latency >30 mins on non-school nights (<0.001) • Abnormal breathing during sleep (0.005) • Emotional symptoms (0.019)	• Sleep initiation habits (<0.001) • Hyperactivity/ inattention (0.001) • Abnormal breathing during sleep (0.005) • Regular daytime napping (0.022) • Poor school performance (0.046)	• TNST on non-school nights (<0.001) • Awakening with help (<0.001)	• TNST on school nights (<0.001) • Awakening with help (<0.001) • Female (0.001) • Regular daytime napping (0.008)	• Morning start time (p<0.001) • Female (p<0.001) • Mother's education <5 years (0.013) • Age (0.043)
No relation	TNST on non-school nights (0.35), passive smoking (0.46), awakening with help (0.37), poor school performance (0.16), conduct problem (0.82), hyperactivity/ inattention (0.52)	Gender (0.08), BMI (0.05), father's education <5 years (0.38), passive smoking (0.52), TV in bedroom (0.21), tea/coffee (0.26), emotional symptoms (0.07), conduct problem (0.93)	Gender (0.19), BMI (0.39), sleep latency >30 min on non-school nights (0.14), sleep initiation habits (0.93), daytime napping (0.52), emotional symptoms (0.77)	Age (0.24), father's education <5 years (0.78)	TNST on school nights (0.22), poor school performance (0.44)

TNST: Total night sleep time.

or more on both school nights and non-school nights although they reported to need to sleep 10.4 hours on average to feel their best during the day. We also detected that one-fifth of the adolescents had sleep latency of longer than 30 minutes. The figures regarding sleep hygiene such as drinking tea/coffee at least 3 evenings per week (59.7%) and television set in the bedroom (46.5%) in our study were also remarkable. In the 2006 Sleep in America poll[22], sleep latency was more than 30 minutes in 27% of high school adolescents. Drinking two or more cups or cans of caffeinated beverages a day was reported by 31% of the adolescents; a television set in the bedroom was present in 60% of the sample. Even though there are some differences, the main figures from our study, which is the first systematic analysis of sleep-wake patterns among Turkish teenagers, are highly consistent with the findings in the other studies[18,20,22]. In a word, it appears that insufficient sleep duration, abnormal sleep circadian rhythm and poor sleep hygiene are worldwide problems in adolescents.

The present study also demonstrated that there were several correlates of the short TNST and prolonged sleep latency in high school adolescents (Table III). School start time was the major determinant variable irrespective of school or non-school nights. The average TNST in adolescents with morning start time was shorter not only on school nights (7.09 vs 7.98 hours) but also on non-school nights (9.35 vs 9.51 hours). Adolescents with a morning start time may be accustomed to waking up earlier, even on non-school mornings. TNST was negatively correlated with age and male gender as well. More specifically, while age was important for TNST on school nights, gender was important for TNST on non-school nights. A negative correlation between TNST and age during adolescence is well known[18]. Our study shows that the correlation between TNST and age exists only on school nights. For non-school nights, TNST showed some other associations such as gender (Table III). There may be some patterns with regard to school or non-school nights that have not been mentioned before in the literature (Table III). Environmental distracting factors such as crowded family, low parental control and television set in the bedroom appeared to be important for TNST on non-school nights in our study. However, for TNST on school nights, environmental factors with negative biological effect on sleep, such as drinking tea/coffee and passive smoking, were more important. The present study also demonstrates that passive smoking, like active smoking[11,12], has a negative effect on sleep not only in adults[23] but also in adolescents.

We also looked into sleep-related behavior habits, some of which have not been well described in the literature with regard to their associations (Tables I and III). Sleep initiation habits were more common in adolescents with sleep-onset insomnia in our study, as expected. Regular daytime napping (8.1% vs 28.4%) and requiring help to wake up in the morning (27% vs 71.1%) were more common in those with a morning start time, whereas habits to initiate sleep were not (Table I). Daytime napping has been reported to be more common in older adolescents and Asian communities[13,22,26,27]. In our study, daytime napping in high school adolescents was associated with morning start time, female gender and the mother's education. Contrary to the report by Giannotti et al.[13], we found a

Table IV. Observed TNSTs According to Some of the Variables Related to TNST

TNST on school nights (n)	
15-16-year-old adolescents with no passive smoking and no tea/coffee drinking	17-18-year-old adolescents with passive smoking and tea/coffee drinking
8.35±1.82 h (201)	6.81±1.07 h (365)
TNST on non-school nights (n)	
Female adolescents with BMI <21 kg/m^2, mothers with school education ≥5 years, household members <5, no TV in bedroom and afternoon start time	Male adolescents with BMI ≥21 kg/m^2, mothers with school education <5 years, household members ≥5, TV in bedroom and morning start time
9.69±1.44 h (32)	8.73±1.60 h (60)

TNST: Total night sleep time.

relation between daytime napping and female adolescents, rather than males, which may be related to cultural differences. The most important factor related to daytime napping in our study was morning start time. Long naps may negatively affect night sleep. However, our study indicates that regular daytime napping has no effect on sleep latency or TNST on school nights (Table III). As sleep deficit is likely to be the main cause of daytime napping, a short daytime nap can be reasonable for high school adolescents, especially for those with a morning start time if they feel the need.

Our study may help to better define the parental influence on the sleep of adolescents. Parental influence on and control of the sleep of adolescents can be expected to be important for optimal sleep. As a matter of fact, in the study by Russo et al.[20], 40.8% of children aged 8-14 years reported that bedtime was established by their parents during schooldays. However, only 9.4% reported that weekend bedtime was set by their parents. In 14-year-old adolescents, it was 18.8% for school days and 1.6% for weekends. Our findings suggest that maternal education rather than paternal education can be considered as a predictor of the strength of parental control. Furthermore, in the light of the association of the mother's education with TNST and daytime napping, it can be proposed that mothers with a relatively lower level of education have weaker control of the sleep habits of their children.

As for the sleep latency, we would like to underline that neither age nor gender was related to sleep-onset insomnia in our study (Table III). On the other hand, abnormal breathing during sleep was a risk factor for sleep-onset insomnia on both school nights and non-school nights. This finding emphasizes that adolescents with insomnia, like adults with insomnia[24,25], should be evaluated for abnormal breathing during sleep.

Our study has some limitations as well as strengths that should be addressed. All questionnaire-based or self-report studies are open to bias for accuracy, which is the main limitation of such studies. On the other hand, this method allows the acquisition of information from study samples on a large scale, which is the strength of those studies. All of our participants were recruited from among high school adolescents. Even though high school adolescents represent most of the adolescents in this age group, the sleep of adolescents not attending school may still have different features. Concerning the non-responder ratio, there was no difference by age, gender, schools, or grades. Nevertheless, even though it was not a large ratio, further analysis might elucidate whether or not the results were associated with non-response bias. Regarding the statistical model, statistically significant pair associations do not necessarily infer true relations all the time. The logistic regression model helps to eliminate complex interactions among independent variables, which is the main strength of our study. For instance, TNST on school nights appeared at first to be correlated with age. However, further analysis with logistic regression model showed no association between these two variables (Table III). Our study describes not only sleep profiles of high school adolescents but also independent associations of sleep-onset insomnia, short TNST and daytime napping, which to our best knowledge is the first such study in the literature. Further, all the analyses were done with the differentiation between school and non-school nights. Despite statistically significant p values, most effect size and R square values were small in our study, which may be seen as another limitation.

We hope that this study will help in better understanding adolescents with sleep problems and will facilitate the development of preventive strategies. It should be noted that most of the factors associated with poor sleep are modifiable factors. Re-scheduling school start times, decreasing smoking in the community, improving sleep hygiene (such as limiting tea/coffee consumption and television sets in bedrooms), increasing formal education in the community (especially in girls, who are the future mothers), and preventing obesity can help adolescents to go to bed earlier and fall asleep more easily and thereby obtain optimal sleep. It should be emphasized that such approaches will not only improve the health of adolescents but also the health of the community.

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