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Association of sleep duration with socio-economic status and behavioural problems among schoolchildren

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ABSTRACT

Aim: In this population-based study, we aimed to determine the total sleep duration (TSD), its association with socio-economic status (SES) and behavioural symptoms among schoolchildren.

Methods: A cross-sectional study was performed among schoolchildren in Istanbul. A structured questionnaire evaluating the sleep schedule variables was filled out by their parents. SES was determined according to the Turkish SES scale.

Results: The mean age of 2669 children was 8.2 ± 2.4 years, and 51% of the students were girls. The mean TSD was 10.20 ± 1.04, and the mean bedtime was 21.57 ± 0.56 (both in hours, minutes ± SD). Boys tended to go bed later ($p = 0.004$) and slept less than girls ($p = 0.02$). The duration of sleep disruptions increased ($p < 0.001$), whereas TSD decreased with age ($p < 0.001$). Multiple linear regression revealed that waking time and TSD decreased significantly ($p < 0.05$) with higher SES among both girls and boys. Sleep fragmentation was associated with habitual snoring, parasomnias, daytime sleepiness and conduct symptoms.

Conclusion: Decreased total sleep duration is more prominent in boys, older children and children among higher socio-economic status. Insufficient sleep attributed to shortened total sleep duration by age and higher socio-economic status might have a negative effect on both sleep hygiene and psychological well-being in schoolchildren.

INTRODUCTION

Sleep hygiene is defined as optimal environmental, scheduling, sleep practice and physiological sleep-promoting factors. Sleep scheduling refers to regular bedtimes, the number and duration of naps and wake times in the context of 'good sleep habits' (1). An adequate amount of good-quality sleep is crucial for optimal child brain development and prefrontal cortex functioning (2).

Recent scientific studies of sleep duration among children reveal a tremendous amount of variation between individuals, especially during childhood (3). While there is no optimal number of sleep hours that may apply to all schoolchildren (4), studies show that total sleep duration (TSD) decreases by age gradually during primary school years (4,5). Sleep patterns may also vary internationally (6,7) and influenced by cultural variations (4,6,7) and socio-economic status (SES).

Major concerns have been expressed about healthy schoolchildren who are sleep deprived in recent studies. Poor sleep hygiene as a result of insufficient sleep may affect up to 20–30% of schoolchildren (8). Chronic sleep deprivation and fragmentation have significant impact on daytime behavioural functioning in schoolchildren such as inattention (9), hyperactivity, sleepiness (2) and school failure in the latest studies (10).

The prevalence of parasomnias (11), habitual snoring (12) and enuresis (13), and association of STD with obesity (14) are studied in Turkey. TSD, its association with SES and behavioural problems have not been studied in a population-based sample in Turkey until now. Our study aims were to determine the association of sleep schedules with gender, age and SES among school-aged children and also to evaluate the behavioural symptoms that might be associated with TSD.

METHODS

Study design and population

This study was part of a population-based project which was conducted to evaluate habitual snoring, sleep schedules and problems, headache and SES among a representative sample of schoolchildren in Istanbul. The sample size calculation and the sampling methodology were described in detail in an article by Isık et al. study (15). Briefly, multistage sampling was used in schools of Istanbul, with a population of approximately 12 million people. Data were

collected in April and May 2007. Approval by the Regional Director of Education, which serves as the Institute of Human Subject Protection Committee for the schools in Istanbul, was obtained prior to the study. The procedure employed was in accordance with the human ethical guidelines of Helsinki declaration.

Questionnaire

A structured questionnaire evaluating the school-day sleep schedule variables during the past week was distributed to the students to be filled out by their parents within 3 days after taking the parental consent. Bedtime, sleep latency, the duration of night waking, morning waking time and TSD (combining nighttime sleep and naps) were used as sleep schedule parameters (Appendix 1). Socio-demographic variables, including SES, daytime sleepiness, habitual snoring, the presence of at least one parasomnia and behavioural parameters, were also evaluated through the questionnaires. Parents reported behavioural measures on a 3-point scale: 0 (never), 1 (sometimes) and 2 (frequently). Inattention, hyperactivity and conduct behaviours were included as behavioural parameters for evaluating externalizing behaviours in children by their parents.

Socio-economic status (SES) levels were determined through an index validated for Turkey (16). The index included the occupation and the educational level of the parents, house ownership, the number of rooms in the house, the presence of various electrical devices in the house (a computer, a washing machine, a dish washer, a VCD, a stereo and a camera), the land value of the house determined according to the location of the house in the city and car ownership.

DATA ANALYSIS

Statistical analyses were performed using SPSS for Windows Release 11.0 (SPSS Turkey, Istanbul, 2008). Scale variables were compared with *t*-test and ANOVA when they followed a normal distribution. Mann–Whitney U and Kruskall–Wallis tests were used for the nonnormally distributed data. TSD, morning waking and bedtime were also analysed through multiple linear regression separately for boys and girls. In the multiple linear regression analyses, β coefficients, standard errors and p values are provided. The TSD among different SES levels was analysed after adjusting for age and gender. $p < 0.05$ was accepted as the level of statistical significance.

RESULTS

The response rate was 93.3%; 2752 of the 2950 distributed questionnaires were returned. Among the returned questionnaires, 2669 (97%) were eligible for evaluating the sleep time and duration parameters. Mean age of the participants was 8.2 ± 2.4 years and 51% were girls. Family history showed that 13.1% of the mothers and 10.8% of the fathers had at least one symptom of sleep disorder in their life. Table 1 presents the association of socio-demographic variables with sleep time and duration. The mean TSD was 10.20 ± 1.04 (hours, minutes ± SD). The mean bedtime was 21.57 ± 0.56 (hours, minutes ± SD), and sleep latency was 14 ± 0.10 (minutes, seconds ± SD). The duration of midnight waking was 5 ± 0.09 (minutes, seconds ± SD), and midnight waking in minutes increased with age ($p < 0.001$). Boys tended to go to bed later ($p = 0.004$) and slept less than girls ($p = 0.02$). Among all age groups, girls tended to sleep longer compared to the boys. As the age

Table 1 The association of socio-demographic variables with sleep time and duration

	Bedtime[†]	Sleep latency[‡]	Night waking[‡]	Morning waking[†]	Sleep duration[†]
Gender					
Girls	21.55 ± 0.50	14 ± 0.09	5 ± 0.09	8.18 ± 1.07	10.23 ± 1.04
Boys	21.59 ± 1.02	14 ± 0.10	5 ± 0.09	8.19 ± 1.05	10.18 ± 1.04
p value	0.004	>0.05	>0.05	>0.05	0.02
Age					
≤7.0	21.58 ± 0.52	13 ± 0.09	4 ± 0.07	8.35 ± 1.05	10.37 ± 1.01
7.1–8.0	21.58 ± 0.49	14 ± 0.10	4 ± 0.09	8.27 ± 1.02	10.28 ± 0.58
8.1–9.0	21.58 ± 0.47	14 ± 0.10	5 ± 0.08	8.17 ± 1.03	10.18 ± 1.02
≥9.1	21.54 ± 1.11	14 ± 0.11	6 ± 0.10	8.03 ± 1.09	10.05 ± 1.09
p value	>0.05	>0.05	<0.001	<0.001	<0.001
SES[§]					
Low	21.52 ± 0.51	15 ± 0.10	7 ± 0.10	8.27 ± 1.12	10.26 ± 1.17
Medium low	21.57 ± 1.14	14 ± 0.10	5 ± 0.09	8.25 ± 1.11	10.25 ± 1.06
Medium	21.59 ± 0.52	14 ± 0.10	5 ± 0.08	8.22 ± 1.05	10.15 ± 1.05
Medium high	22.00 ± 0.48	13 ± 0.09	5 ± 0.10	8.20 ± 1.02	10.20 ± 0.58
High	21.51 ± 0.41	13 ± 0.10	4 ± 0.06	7.58 ± 0.58	10.07 ± 0.54
p value	>0.05	>0.05	>0.05	<0.001	0.001
Total	21.57 ± 0.56	14 ± 0.10	5 ± 0.09	8.18 ± 1.06	10.20 ± 1.04

[†]Expressed in terms of hours, minutes; ±SD.
[‡]Expressed in terms of minutes; ±SD.
[§]SES = Socio-economic status.

Table 2 The association of various factors with sleep time and duration

	Bedtime†	Sleep latency‡	Night waking‡	Morning waking†	Sleep duration†
Hyperactivity					
No	21.55 ± 1.00	0.14 ± 0.10	0.05 ± 0.09	8.16 ± 1.08	10.19 ± 1.05
Sometimes	21.57 ± 0.49	0.14 ± 0.09	0.05 ± 0.09	8.21 ± 1.03	10.23 ± 1.01
Frequently	22.04 ± 0.54	0.14 ± 0.11	0.05 ± 0.09	8.24 ± 1.05	10.19 ± 1.04
p value	0.017	>0.05	>0.05	0.035	>0.05
Conduct symptoms					
No	21.57 ± 0.50	0.13 ± 0.09	0.05 ± 0.09	8.18 ± 1.06	10.20 ± 1.05
Sometimes	21.55 ± 0.50	0.14 ± 0.11	0.05 ± 0.09	8.20 ± 1.06	10.24 ± 1.02
Frequently	22.00 ± 1.43	0.15 ± 0.11	0.06 ± 0.09	8.21 ± 1.11	10.12 ± 1.05
p value	>0.05	0.005	0.002	>0.05	>0.05
Inattentiveness					
No	21.58 ± 0.50	0.13 ± 0.09	0.05 ± 0.09	8.19 ± 1.06	10.21 ± 1.05
Sometimes	21.56 ± 1.06	0.14 ± 0.11	0.05 ± 0.09	8.19 ± 1.04	10.21 ± 1.01
Frequently	21.59 ± 0.51	0.16 ± 0.11	0.06 ± 0.09	8.17 ± 1.10	10.15 ± 1.09
p value	>0.05	0.01	0.054	>0.05	>0.05
Habitual snoring					
No	21.57 ± 0.59	0.14 ± 0.10	0.05 ± 0.09	8.19 ± 1.06	10.21 ± 1.04
Sometimes	21.57 ± 0.48	0.14 ± 0.10	0.05 ± 0.08	8.17 ± 1.05	10.20 ± 1.02
Frequently	22.00 ± 0.54	0.12 ± 0.09	0.07 ± 0.10	8.19 ± 1.11	10.19 ± 1.02
p value	>0.05	>0.05	0.004	>0.05	>0.05
Parasomnia presence§					
No	21.57 ± 0.48	0.13 ± 0.10	0.04 ± 0.08	8.15 ± 1.03	10.17 ± 1.01
Yes	21.58 ± 1.03	0.14 ± 0.10	0.06 ± 0.09	8.22 ± 1.08	10.23 ± 1.06
p value	>0.05	>0.05	<0.001	0.021	>0.05

†Expressed in terms of hours, minutes; ±SD.
‡Expressed in terms of minutes; ±SD.
§Presence of at least one parasomnia expressed in.

increased, sleep duration showed a decreasing linear trend among both girls and boys. The TSD was shorter ($p = 0.001$), and wake-up time was earlier ($p < 0.001$) among children with higher SES compared to the lower ones. As SES improved, both girls and boys had a shorter TSD.

The association of behavioural problems with sleep time and TSD is evaluated through univariate analyses (Table 2). It was determined that hyperactivity was a significant factor in determining bedtime. Children with hyperactivity tended to go to bed later compared to the children who did not experience such symptoms ($p = 0.017$) and were also more likely to wake up later in the morning ($p = 0.035$). The presence of conduct symptoms was associated significantly with increased sleep latency ($p = 0.005$) and night waking ($p = 0.002$). Inattentiveness was also associated with sleep latency in the univariate analyses. The presence of habitual snoring ($p = 0.004$) and the presence of at least one parasomnia in the child ($p < 0.001$) were associated with night waking in the univariate analyses. Although a statistically significant association was determined, there were very small changes among the groups. However, as there were only slight changes as 1 min among the groups, it was considered clinically unimportant.

Variables that might be associated with bedtime, TSD and morning waking were evaluated through multiple linear regression, separately for boys and girls (Table 3). It was determined that age had a negative relationship with morning waking ($p < 0.001$) and with TSD ($p < 0.001$) for boys. Significant negative relationship between age and morning waking ($p < 0.001$), and TSD ($p < 0.001$) was also seen for the girls. Total sleep duration decreased significantly for both boys ($p = 0.003$) and girls ($p = 0.007$) with higher SES. Among girls, the presence of parasomnia increased TSD and delayed morning waking ($p < 0.05$). Yet, such an association was not observed among the boys ($p > 0.05$).

Table 3 Factors associated with sleep time and duration among boys and girls, multivariate analysis

	Morning waking			Sleep duration		
	β	SE	p value	*β*	SE	p value
Boys						
Age	−10.0	2.0	<0.001	−9.8	2.0	<0.001
SES†	−7.7	1.9	<0.001	−5.8	1.9	0.003
Girls						
Age	−7.8	2.03	<0.001	−8.8	2.0	<0.001
SES	−4.2	1.99	0.035	−5.2	1.9	0.007
Parasomnia presence‡	8.5	4.4	0.054	12.9	4.2	0.002

†Socio-economic status.
‡Presence of at least one parasomnia expressed in.

The change in sleep schedule parameters might affect daytime sleepiness as a consequence rather than having a bidirectional association, so the data were not shown in Table 2. The daytime sleepiness significantly increased with increased duration of night waking (5 ± 0.09 vs. 9 ± 0.01 min ± SD) ($p < 0.01$), with earlier morning wake-up time (8.20 ± 1.05 vs. 7.41 ± 1.18 h, min ± SD) and with shortened TSD (10.21 ± 1.03 vs. 9.42 ± 1.13) ($p < 0.05$ for both).

DISCUSSION

Our study findings suggest that TSD in schoolchildren differed significantly by gender, increasing age and higher SES. Behavioural parameters such as daytime sleepiness and conduct symptoms were significantly associated with sleep fragmentation; however, these differences were very small. The mean TSD was 10.20 ± 1.04 h, which was comparable to other studies (4,6,17). Age was the major determinant of sleep duration, and TSD showed a decreasing linear trend among both girls and boys as age increased. The normal sleep pattern of schoolchildren continues to evolve with advancing age, and the average sleep requirements decline from 11.1 h at 5 years of age to 10.2 h by age 9 (3). According to a telephone survey conducted by the National Sleep Foundation in 2004, an international trend towards shorter TSD for schoolchildren was determined (17). In addition, recent longitudinal follow-up studies in Finland (18), Iceland (19) and Australia (20) suggest that children in these countries sleep less than did children in 1974–1986 Swiss cohort (4).

The duration of night waking, morning wake-up time and TSD were significantly associated with daytime sleepiness in our study group. Significant daytime sleepiness is highly unusual in preadolescents, and repeated sleepiness at this age is a strong indicator of a serious underlying sleep disorder (21).

Subjectively reported sleep problems are common during the school-age years. In one large survey studying sleep problems affecting 5- to 12-year-old children, bedtime resistance was reported in 27%, sleep-onset delays in 11.3% and excessive night waking in 6.5% (22). In Mindell's et al. study (17), sleep problems were commonly reported across the ages, with a large percentage of children reporting to experience waking during the night. Sadeh et al. (23) pointed out the high prevalence of fragmented sleep in a nonclinical sample of school-age children and warned about the potential adverse effects on subsequent daytime functioning. Prolonged sleep disruption was the most prominent finding significantly associated with habitual snoring, parasomnias, daytime sleepiness and conduct symptoms in our study.

Bedtime resistance and insomnia are commonly reported as children grow older (3,5). Several important developmental influences may have a direct effect on these phenomena. Schoolchildren typically have increasing autonomy in setting their bedtime as they grow older which often results in irregular sleep schedules disrupting the sleep quality (4). In addition, the physiological tendency towards delayed circadian phase during later childhood may result in daytime tiredness in schoolchildren (3).

There are a few studies evaluating the association of sleep STD and SES in children. However, the results are conflicting. Buckhalt et al. (24) have stated that children from lower and higher SES had similar cognitive performance with better sleep quality and less variability in sleep schedules. We observed that children with a higher SES slept less compared to the ones with a lower status. Similarly, the average sleep time in Chinese urban children was shorter, whereas the rate of night waking was higher than in the children from rural areas in Yang et al. study (25). Contrary to earlier studies identifying poorer children at higher risk (26,27), Smaldone et al. (1) stated that parents with higher SES reported more concern about inadequate sleep in their children. Higher SES would shorten sleep duration of children by delaying bedtime. Internet use, watching TV, playing video games and heavy homework in high SES children may shorten sleep duration. Earlier waking times in the morning possibly because of both parents going outside home for work in higher SES group might be another explanation for our findings.

Shortened TSD may manifest in children as externalizing behavioural symptoms including inattention, hyperactivity and conduct problems (28). Hyperactivity significantly delayed bedtime among boys, while the presence of parasomnia increased TSD among girls. In a cross-sectional study made by Paavonen et al. (29), Finnish schoolchildren with a short TSD and sleep difficulties had an increased risk of behavioural symptoms of attentional control and externalizing behaviours. Only limited data are presently available regarding the neurobehavioural effects of insufficient sleep. Recent studies focus on exploring the relations between sleep and cognitive functioning in healthy children (10,30). Dahl described a developmental model in which sleep disturbances are thought to affect prefrontal cortex functions such as synchronization of attention and arousal in performing goal-directed tasks (2).

As a methodological concern, the description of sleep variables in this study depended on parental reports. Data were not collected on existing medical/psychiatric disorders, as well as medications that may affect sleep, which may have influenced the results. Given the clear findings of this study, however, the association between sleep parameters, SES and behavioural measures are remarkable. This study utilized a large representative sample and the response rate was high. Also, a validated index was used, which reflects different socio-economic classes properly.

As a conclusion, sleep hygiene assessment should be a fundamental aspect of clinical evaluation both in paediatric and child psychiatry settings. Variables such as age, gender and SES might have major effects on sleep time and duration. Social causation might have a fundamental role on sleep schedule variables. Our study provided background data for further investigation of environmental variables that may underlie these differences.

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APPENDIX 1

Following statements are about your child's sleep habits and sleep-related difficulties. Answer these questions thinking about school days of the last week. If last week was unusual because of a specific reason (your child might have had an infection with high fever and could not sleep well or there might have been a change in everyday routines because of a move or restoration), think about the most recent week in your normal routine.

Sleep parameters
Bedtime
Write your child's bedtime: _____

Sleep latency
Write the average amount of time your child spends in bed until he/she gets asleep in minutes:_____

Waking during the night
Write how long does the child remain awake when he/she wakes up during night in minutes: _____

Morning waking
Write in the time of day child usually wakes in the morning:

Total sleep duration
Your child's overall amount of sleep each day: ___h, __min (a total of night time and day time sleep).