Sleep duration and its correlates in a sample of Saudi elementary school children

BaHammam A, Bin Saeed A, Al-Faris E, Shaikh S

ABSTRACT

Introduction: This study was conducted to estimate sleep duration in Saudi elementary school children, sleep habits and practices that may affect it, and compare our results to published data in other societies.

Methods: Parents of elementary school children were surveyed regarding their children's bedtime, rise time, sleep duration at night and daytime nap duration during weekdays and weekends. A questionnaire inquiring about demographical data, specific sleep problems and habits, and home environment was completed by the parents.

Results: The study comprised 511 (50.5 percent) boys and 501 (49.5 percent) girls. During weekdays, bedtime for the whole group was 21.3 +/- 1.8 hours, rise time was 5.9 +/- 0.5 hours, total sleep time (TST) was 8.4 +/- 1.1 hours, and TST and nap was 9.98 +/- 1.3 hours. Multivariate analysis revealed that TST was affected by regularity of bedtime, mother's level of education, daytime naps, and the habits of watching television (TV) and playing computer games after 20.00 hours.

Conclusion: Nighttime sleep duration is shorter in Saudi school children compared to published data. Several factors appeared to affect sleep duration, including mother's educational level, daytime naps and watching TV at night.

Keywords: children, elementary school, primary school, sleep, sleep duration

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INTRODUCTION

Sleep is an essential component of our 24-hour cycle. We all need sleep to be able to function the next day. However, the unanswered question is: how much sleep do we need? Sleep researchers do not seem to agree on how much we should sleep. The above question is even more difficult to answer when sleep for children is addressed. The concern regarding the number of hours needed to ensure adequate functioning of school children has been raised long ago. In the early years of the past century, researchers seemed to agree that school children slept less than they should[1]. It is well known that sleep duration in children decreases with age[2]. Other factors, like cultural and climatic factors, appear to affect sleep duration in children. American children were reported to sleep 1-1.5 hours more than their European counterparts[3,4].

The time of starting school seems to affect sleep duration in children as well. While American children started school at 09.00 hours, their European counterparts started school at 08.00 hours. Israeli school children were reported to have the shortest duration of sleep[4]. This correlates with the fact that schools start at an earlier time (around 07.15 hours) in Israel[5]. Epstein et al[5] reported that the mean sleep time of children who started school earlier (07.15 hours or earlier) was significantly shorter than those who started school later (08.00 hours or after). It seems that the earlier the starting time of schools, the shorter the sleep duration for children. Modern civilisation and new changes in lifestyle seem to be another factor affecting sleep duration. It has been demonstrated that bedtimes for school children have gradually become later, although rise time did not change regardless of age[6]. As a result, nocturnal sleep became shorter by around one hour over the past ten years[6].

Although sleep deprivation in medical students in Saudi Arabia have previously been reported[7], sleep duration in elementary school children in Saudi Arabia has not been investigated before. The purpose of the present study was to estimate sleep duration in Saudi elementary school children, their sleep habits and practices that may affect it, and compare our results to published data in other societies.

Sleep Disorders Centre
College of Medicine
King Saud University
PO Box 225503
Riyadh 11324
Saudi Arabia

BaHammam A, FRCP, FCCP
Associate Professor and Director

Department of Family and Community Medicine

Bin Saeed A, MD, PhD
Chairman

Al-Faris E, MD, FRCGP
Professor

Shaikh S, MSc, PhD
Assistant Professor

Correspondence to:
Dr Ahmed BaHammam
Tel: (966) 1 467 1521
Fax: (966) 1 467 2558
Email:ashammam2@yahoo.com

METHODS

This cross-sectional study was conducted in Riyadh, which has a population of more than 4 million[8]. Data for this study were a subset of a larger database that was collected for a big project to assess sleep patterns in elementary school children. The study population comprised boys and girls attending regular governmental elementary schools in all grades. Elementary schools in Saudi Arabia include students from grade one to grade six. Students in the study were almost evenly distributed between the six grades of school, ranging from 15.4% to 19.2%. We explained the aims of the project to the local educational authority and obtained their permission to carry out the survey. A random sample of ten boys' schools and ten girls' schools were selected. Then, at each school, a further random sampling was carried out to select classes. All children in the selected class were included in the study. The investigation was conducted in the spring of 1999 where all schools started at 07.00 hours, and ended between 12.00 and 13.00 hours, depending on the grade (usually, students are required to report to school before 06.45 hours).

A questionnaire inquiring about demographical data, specific sleep problems and habits, and home environment was prepared, based on clinical experience and literature[5,9]. The eligibility and stability of the questionnaire were tested on an independent sample of parents of elementary school children, and found to be satisfactory. Among the data collected in the main project, questions addressing bedtime, rise time, nighttime sleep duration and daytime nap duration during both weekdays and weekends were assessed during the preceding four months. In this paper, nighttime sleep duration will be called "total sleep time (TST)", and nighttime and daytime sleep durations will be called "TST + nap". The questionnaire included two formats of questions: closed questions with multiple choices, for example "Does your child have regular sleep-wake schedule? (yes/no/I do not know)," and open-ended questions to be completed with proper answers. 1,200 questionnaires were distributed.

Bedtime and rise times were assessed by direct questioning regarding the usual bedtime and rise time for the child. Daytime naps and sleep habits and practices were considered to be present if the practice occurred at least three times per week. Self-administered questionnaires with letters addressed to the parents explaining the survey, its procedures and its aim were distributed to the selected school children by trained medical students. After giving consent, parents or legal guardians were asked to fill in the questionnaire, following the instructions that were included in the letter. Out of 1,200 distributed questionnaires, 1,012 were returned.

The data was expressed as mean ± standard deviation (SD) in the text and tables, and as mean ± standard error of the means (SEM) in the graphs. Student's t-test was used to compare continuous data. If the normality test failed, the rank sum test was used. For categorical data, the chi-square test was used. Results were considered statistically significant at $p<0.05$. Pearson's correlation was used to assess the relationship between the child's and mother's bedtimes. To explore associations between independent factors (i.e. sleep habits and practices) and nighttime sleep duration, a univariate linear regression model was initially used and subsequently, variables with p-value less than 0.2 were evaluated using a multivariate using linear regression model, to examine the effect of certain factors on nighttime sleep duration. The use of large p-value, 0.20 or even more, as a screening criterion for selection of candidate variables, is to ensure adequate power to detect any important variable effect. Variables with the strongest independent effects were selected, in the case of collinear or redundant factors. Standard statistical software (Sigma Stat, version 3, Chicago, IL, USA) was used for the analyses.

RESULTS

The surveyed group comprised 1,012 elementary school students with ages ranging from 6-13 years, distributed from grade one to grade six (mean age of 9.5 ± 1.9 years). There were 511 (50.5%) boys and 501 (49.5%) girls. Questionnaires were completed by mothers (47.2%), fathers (38.5%), and by others (14.3%). The educational level of the students' parents was variable. Illiteracy rate was 11.9% among mothers and 5.7% among fathers. Nearly 65.0% of mothers and 57.0% of fathers had primary, secondary or high school education. 23.0% and 37.8% of mothers and fathers, respectively, had graduate or postgraduate education. Mothers' occupations were as follows: housewives (74.9%), teachers (18.4%), medical profession (4.2%), and administrators (2.5%).

The bedtimes, rise times, TST during weekdays and weekends, and TST + nap for the whole group and different age groups (boys and girls), are listed in Table I. Bedtime for the whole group was 21.3 ± 1.8 hours and rise time was 5.9 ± 0.5 hours. During weekdays, TST was 8.4 ± 1.1 hours and TST + nap was 9.98 ± 1.3 hours. TST during weekdays was significantly reduced with age. It decreased from 8.8 ± 1.3 hours for children aged 5-6 years, to 7.9 ± 1.1 hours for children aged 13 years ($p<0.001$). Among the whole group, TST was significantly

Table I. Sleep pattern in the whole group and comparison between boys and girls at different age.

		Whole group	Boys	Girls	p-value
	Bedtime WD	21.3 ± 1.8	21.4 ± 1.8	21.3 ± 1.7	NS
	Rise time WD	5.9 ± 0.5	5.9 ± 0.57	5.9 ± 0.4	NS
Whole group (n=1,012)	TST WD	8.4 ± 1.1	8.3 ± 1.1	8.5 ± 1.2	0.006
Boys (n=511)	TST + naps WD	9.98 ± 1.3	9.9 ± 1.3	10.02 ± 1.3	NS
Girls (n=501)	Bedtime WE	23.1 ± 7.1	22.9 ± 2.6	23.2 ± 9.8	NS
	Rise time WE	9.3 ± 1.6	9.1 ± 1.7	9.4 ± 1.6	0.002
	TST WE	9.96 ± 1.4	9.85 ± 1.4	10.1 ± 1.4	0.02
	Rise time WE	9.3 ± 1.6	9.1 ± 1.7	9.4 ± 1.6	0.002
	Bedtime WD	20.5 ± 3.7	21.2 ± 1.1	19.97 ± 4.7	NS
5-6 years (n=35)	Rise time WD	5.9 ± 0.6	6.2 ± 0.8	5.8 ± 0.4	0.035
Boys (n=55)	TST WD	8.8 ± 1.3	9.03 ± 0.8	8.6 ± 1.6	NS
Girls (n=27)	TST + nap WD	9.4 ± 1.2	9.5 ± 0.9	9.2 ± 1.4	NS
	Bedtime WE	23.2 ± 1.3	23.1 ± 0.9	23.3 ± 1.5	NS
	Rise time WE	9.3 ± 1.3	9.5 ± 0.8	9.2 ± 1.5	NS
	TST WE	10.1 ± 1.01	10.3 ± 0.6	9.95 ± 1.2	NS
	Bedtime WD	21.2 ± 1.04	21.3 ± 1.08	21.1 ± 0.99	NS
	Rise time WD	5.97 ± 0.4	6.02 ± 0.5	5.9 ± 0.4	NS
7 years (n=141)	TST WD	8.7 ± 1.02	8.7 ± 1.0	8.8 ± 1.05	NS
Boys (n=73)	TST + nap WD	9.4 ± 1.3	9.3 ± 1.2	9.5 ± 1.3	NS
Girls (n=68)	Bedtime WE	22.8 ± 1.6	22.7 ± 1.2	23.06 ± 1.3	NS
	Rise time WE	9.1 ± 1.6	9.15 ± 1.9	9.08 ± 1.2	NS
	TST WE	10.04 ± 1.3	10.04 ± 1.3	10.03 ± 1.3	NS
	Bedtime WD	21.3 ± 1.1	21.27 ± 0.99	21.3 ± 1.17	NS
	Rise time WD	5.9 ± 0.46	5.9 ± 0.4	5.9 ± 0.5	NS
8 years (n=170)	TST WD	8.6 ± 1.01	8.67 ± 0.9	8.6 ± 1.07	NS
Boys (n=91)	TST + nap WD	9.4 ± 1.3	9.3 ± 1.3	9.5 ± 1.3	NS
Girls (n=79)	Bedtime WE	23.17 ± 1.15	22.9 ± 1.1	23.4 ± 1.1	0.007
	Rise time WE	9.3 ± 1.5	9.1 ± 1.5	9.5 ± 1.5	NS
	TST WE	10.1 ± 1.2	10.2 ± 1.3	10.05 ± 1.1	NS
	Bedtime WD	21.15 ± 1.85	21.45 ± 1.1	21.2 ± 1.03	NS
	Rise time WD	5.85 ± 0.5	5.87 ± 0.56	5.9 ± 0.4	NS
9 years (n=157)	TST WD	8.5 ± 1.1	8.4 ± 1.1	8.65 ± 1.1	NS
Boys (n=75)	TST + nap WD	9.15 ± 1.4	8.99 ± 1.4	9.3 ± 1.3	NS
Girls (n=82)	Bedtime WE	23.1 ± 1.3	23.2 ± 1.3	23.04 ± 1.3	NS
	Rise time WE	8.97 ± 1.6	8.8 ± 1.8	9.1 ± 1.5	NS
	TST WE	9.86 ± 1.4	9.6 ± 1.4	10.06 ± 1.4	0.02
	Bedtime WD	21.5 ± 1.15	21.6 ± 1.03	21.45 ± 1.2	NS
	Rise time WD	5.9 ± 0.5	5.8 ± 0.6	5.88 ± 0.4	NS
10 years (n=172)	TST WD	8.37 ± 1.19	8.3 ± 1.1	8.45 ± 1.2	NS
Boys (n=73)	TST + nap WD	9.2 ± 1.3	8.96 ± 1.4	9.37 ± 1.3	NS
Girls (n=99)	Bedtime WE	23.37 ± 1.3	23.4 ± 1.3	23.4 ± 1.3	NS
	Rise time WE	9.5 ± 1.6	9.3 ± 1.8	9.6 ± 1.47	NS
	TST WE	10.1 ± 1.3	9.9 ± 1.5	10.26 ± 1.2	NS
	Bedtime WD	21.7 ± 1.1	21.8 ± 0.9	21.7 ± 1.2	NS
	Rise time WD	5.8 ± 0.5	5.8 ± 0.6	5.8 ± 0.4	NS
>10 years (n=290)	TST WD	8.07 ± 1.1	8.0 ± 0.96	8.1 ± 1.2	NS
Boys (n=144)	TST + nap WD	8.9 ± 1.3	8.8 ± 1.2	8.9 ± 1.4	NS
Girls (n=146)	Bedtime WE	23.4 ± 2.2	23.4 ± 1.1	23.7 ± 1.4	0.04
	Rise time WE	9.35 ± 1.8	9.1 ± 1.8	9.7 ± 1.8	0.003
	TST WE	9.8 ± 1.6	9.6 ± 1.6	9.98 ± 1.6	0.02

TST WD: total sleep time during weekdays, TST + nap WD: total sleep time + naps during weekdays, TST WE: total sleep time during weekends.

longer for girls when compared to boys. However, when the whole group was stratified by age, not much difference could be elicited between boys and girls in most age groups. In the oldest age group (>10 years), there was a significant delay in bedtime and rise time for girls with a significantly longer TST.

Almost half of the surveyed children used to have daytime naps during weekdays, while there were no daytime naps during weekends. Nap duration was 1.6 ± 0.9 hours for the whole group, and 1.6 ± 0.8 hours and 1.55 ± 1.0 hours in boys and girls, respectively. The bedtimes, rise times and TST during weekdays compared to weekends for each age group is shown in Figs. 1a-c. It appears clearly that bedtime and rise time were significantly delayed during weekends ($p<0.001$). Moreover, TST increased significantly during weekends in all age groups ($p<0.001$). The increments ranged from 1.3-1.8 hours, being more in the older age groups. There was no correlation between student's and mother's bedtimes during weekdays ($r=-0.06$, $p=0.06$) or weekends ($r=0.08$, $p=0.02$).

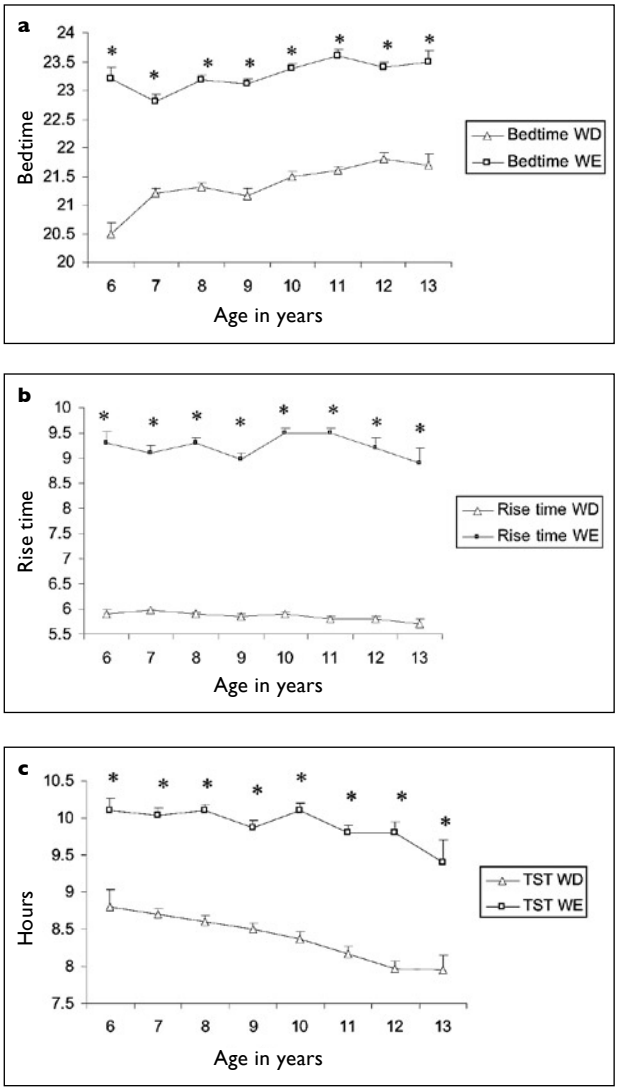

Fig. 1 Comparison of age versus (a) bedtimes during weekdays (WD) and weekends (WE); (b) rise times during weekdays and weekends; and (c) nighttime sleep duration (TST) during weekdays and weekends. * shows the statistically significant difference between weekdays and weekends.

Bedtime for students whose mothers were illiterate or had elementary school education was significantly delayed (21.7 ± 1.2 hours and 21.6 ± 1.3 hours, respectively), compared to students whose mothers had university or postgraduate education (21.4 ± 1.4 hours, $p=0.002$). Moreover, TST during weekdays was significantly more in students whose mothers had high school or higher education (8.5-8.7 hours) compared to students whose mothers were illiterate or had elementary school education (8.1 ± 1.2 hours and 8.2 ± 1.3 hours, respectively, $p<0.001$). Additionally, TST during weekdays was significantly more in students whose mothers were working (8.6 ± 1.1 hours) compared to students whose mothers were housewives (8.4 ± 1.2 hours, $p=0.005$). No relation could be found between father's level of education or job status and student's sleep.

The factors affecting nighttime sleep duration during weekdays after applying a univariate linear regression model is shown in Table II. Those who had irregular bedtime, watched TV after 20.00 hours, played computer games after 20.00 hours, watched TV at bedtime or took daytime nap slept significantly less at night. The results of the multivariate regression analysis are shown in Table III. Children who had regular bedtime slept 0.48 hour (28.8 minutes) longer. Moreover, children whose mothers had high school education or higher had longer nighttime sleep duration compared to children whose mothers had lower educational level. Watching TV or playing computer games after 20.00 hours and daytime naps were independent predictors of nighttime sleep duration.

DISCUSSION

To our knowledge, this is the first study to report sleep duration in different age groups in the Arab countries. The study showed that sleep duration in the study sample of elementary school children is the shortest among reported data from other countries. Most previous studies examined a small number of children and were focused on limited age groups. Iglowstein et al[10] assessed sleep duration from infancy to adolescence and tried to develop reference values and generation trends in a sample of 493 Swiss children. Moreover, most of the previously published studies did not address the issue of daytime naps. Comparison of TST and TST + nap in different age groups in the present study, in Iglowstein et al's study[10] and TST in

Table II. Factors affecting nighttime sleep duration (TST) during weekdays after applying a univariate linear regression model.

Factor	Adjusted effect in hours*	Effect in minutes*	p-value	95% confidence interval
Sleep regularly	0.73	43.8	<0.001	(0.59, 0.88)
Sharing bedroom	0.01	0.6	0.95	(-0.34, 0.36)
Sharing bed	0.09	5.4	0.44	(-1.53, 0.35)
Sleep with parents	-0. 11	-6.6	0. 19	(-0.28, -0.06)
Watch TV after 20.00 hours	-0.63	-37.8	<0.001	(-7.9, -0.47)
Play computer games after 20.00 hours	-0.46	-27.6	<0.001	(-0.61, -0.31)
Watch TV at bedtime	-0.27	-16.2	0.001	(-0.42, -0.12)
Does your child get enough sleep?	0.65	39	<0.001	(0.50, 0.81)
Daytime naps	-0.71	-42.6	<0.00	(-0.89, -0.53)
Refuse to go school	-0.17	-10.2	0.12	(-0.38, 0.04)
Sleep in class	-0.51	-30.6	<0.001	(-0.75, -0.26)
Mothers' educational level	0.12	7.2	<0.001	(0.06, 0.18)
Fathers' educational level	-0.001	-0.06	0.90	(-0.06, 0.06)
Working mothers	0.20	12	0.02	(0.04, 0.37)
Medical illness	-0.29	-17.4	0.007	(-0.49, -0.08)
Psychological illness	0.08	4.8	0.56	(-0.18, 0.34)

* Beta coefficient

Table III. Multivariate analysis of factors that affect nighttime sleep duration (TST) during weekdays.

Factor	Adjusted effect in hours*	Effect in minutes*	p-value	95% confidence interval
Sleep regularity	0.48	28.98	<0.001	(0.29, 0.67)
Watch TV after 20.00 hours	-0.271	-16.26	0.01	(-0.48, -0.06)
Computer games after 20.00 hours	-0.25	-15	0.02	(-0.45, -0.05)
Daytime naps	-0.504	-30.24	<0.001	(-0.72, -0.29)
Refuse to go to school	0.336	20.16	0.02	(0.06, 0.61)
Sleep in class	-0.34	-20.4	0.02	(-0.64, -0.05)
Mothers' educational level	0.2	12	<0.001	(0.12, 0.28)
Fathers' educational level	-0.119	-7.14	0.004	(-0.20, -0.04)
Working mothers	-0.09217	-5.5302	0.40	(-0.31, 0.12)

* Beta coefficient

Ng et al's study conducted among primary school children in Hong Kong[11], is shown in Table IV. TST + nap was lower for all age groups in Saudi children compared to Swiss children and TST was lower in all age groups in Saudi children compared to children in Hong Kong.

Sleep duration in the present study was lower than that reported in other studies in Western countries. Tynjälä et al reported sleep duration in pre-adolescent children (11-13 years) in ten European countries and Israel[4]. The shortest sleep durations were reported among Finnish and Israeli children. Israeli students reported sleep durations of nine hours in children aged 11-12 years, and 8.6 hours of sleep in children aged 13-14 years. Sleep durations reported in the present study were shorter compared to the results of the above study. Although the differences in sleep duration may appear relatively small compared to previously published studies, it may be physiologically important. Sadeh et al have recently shown that modest changes in sleep duration (≥30 minutes) improve (in the case of extension) and worsen (in the case of restriction) neurobehavioural function[12]. As there is no evidence in the literature to show that certain ethnic groups may need less sleep, efforts should be directed to find solutions to increase night sleep among school-aged children.

A very interesting finding in this study is the high rate of napping among children. In the study by Iglowstein et al, after the age of seven years, the habit of napping dropped significantly to less than 0.9%[10]. Other studies conducted in Western societies have shown similar results[13]. In the current study,

Table IV. Comparison of nighttime sleep duration (TST) and nighttime sleep duration + naps (TST + nap) in the present study and Western societies.

Age group (years)	Present study		Iglowstein et al's study[10]		Ng et al's study[11]
	TST	TST + nap	TST	TST + nap	TST
5-6	8.8 ± 1.3	9.4 ± 1.2	10.9 ± 0.7	11.0 ± 0.8	9.1 ± 0.98
7	8.7 ± 1.02	9.4 ± 1.3	10.7 ± 0.7	10.6 ± 0.7	8.9 ± 0.93
8	8.6 ± 1.01	9.4 ± 1.3	10.4 ± 0.7	10.4 ± 0.6	8.87 ± 0.93
9	8.5 ± 1.1	9.2 ± 1.4	10.2 ± 0.7	10.1 ± 0.6	8.8 ± 0.95
10	8.4 ± 1.2	9.2 ± 1.3	9.9 ± 0.6	9.9 ± 0.6	8.72 ± 0.92
11	8.2 ± 0.9	9.0 ± 1.1	9.6 ± 0.6	9.6 ± 0.6	8.55 ± 0.98
12	8.0 ± 1.3	8.8 ± 1.3	9.3 ± 0.7	93 ± 0.6	8.6 ± 0.98
13	7.9 ± 1.1	8.8 ± 1.3	9.0 ± 0.7	9.0 ± 0.7	

In Iglowstein et al's study, TST + nap may appear shorter than TST as children without daytime napping were excluded.

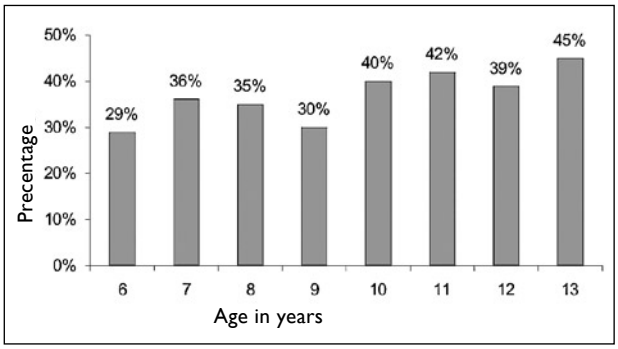

Fig. 2 Percentage of children who take regular daytime naps in different age groups.

children continued to have a high rate of napping across different age groups (Fig. 2). This finding may reflect sleep deprivation during weekdays[14], as napping did not exist during the weekends, or reflect cultural differences, as napping seems to be related to cultural practices. Unfortunately, we do not have data from countries that have similar childrearing and cultural backgrounds to which to compare our results. Short daytime naps (usually less than 30 minutes) are proven to be a facilitating factor for daytime functioning in adults[15,16]. However, nap duration in our sample is quite long (96 minutes), which may be one of the reasons for the delayed bedtime in this group[17].

Sleep duration was significantly more during the weekends. This finding has also been reported in other countries[18,19]. However, the difference between sleep duration on weekends and weekdays in our sample is much more than that reported in Western societies, pointing to the fact that our school children may be sleep deprived during weekdays and have significant sleep debt. It has been shown that the differences between sleep-wake patterns during the weekdays and weekends completely disappear during vacations, suggesting that school children are sleep deprived during weekdays and recover on weekends[18]. Our findings seem to concur with previous reports that show that there are not much gender-related differences in sleep duration in prepubertal children[10,15]. TST decreased with increasing age in children (Fig. 1c and Table I). Our results showed that TST decreased by 6-12 minutes per year. Other studies reported a reduction in TST ranging from 16-20 minutes per year[18,21,22].

The duration and subjective quality of sleep in school children may be affected by lifestyle, environmental and social factors[5,23,24]. The current study showed that sleep duration of children, whose mothers had higher education or were employed, was longer. Further research is needed to explore the effect of social status on sleep habits and sleep duration in school-aged children. The fact that sleep duration was assessed using the parent's report is a limitation of this study. However, sleep durations obtained using parental reports have been shown to be reliable[25,26]. Sadeh reported that parents overestimated sleep duration on average by only 14 minutes, compared to objective methods[26]. Furthermore, as sleep duration could be affected by environmental and social factors, the present findings cannot be extrapolated to rural areas in Saudi Arabia.

In summary, this study provides, for the first time, estimates of sleep duration in school-aged children in Saudi Arabia. TST is shorter in Saudi school-aged children, compared to published data. Several factors appeared to affect sleep duration, including educational level and employment of the mothers, daytime naps and watching TV at night. Further studies are needed to explore the practice of daytime naps among school children, assess sleep duration and practices in rural areas, and to assess the effect of sleep problems and habits on school performance.

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