

Starting Times of School: Effects on Daytime Functioning of Fifth-grade Children in Israel

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Summary: In the present study we investigated the effects of school starting time on daytime behavior and sleep. Eight-hundred and eleven 5th grade pupils (10-12 years old) from 28 classes in 18 schools throughout Israel were divided into "early risers" (N= 232) who started school at 07:10 (42%) at least 2 times a week, and "regular risers" (N=340) who always started school at 08:00 (58%). The remaining 239 pupils started school between 7:20 and 07:55 (and also after 08:00), and were not included in the study. Self-administered questionnaires concerning sleep habits during school days, weekends, and holidays, daytime fatigue, sleepiness, and difficulties concentrating and paying attention in school were completed by all children. Mean sleep time of the "early risers" was significantly shorter than that of the "regular risers." Early risers complained significantly more about daytime fatigue and sleepiness, and about attention and concentration difficulties in school. Their complaints were independent of the reported hours of sleep. We conclude that early starting of school negatively affects total sleep time and, as a consequence, has a negative effect on daytime behavior. The implications of these findings to the ongoing controversy concerning sleep need in contemporary society are discussed.

Key words: Pupils; sleep habits; sleep duration

THE QUESTION OF HOW MUCH SLEEP is required to ensure proper daytime functioning in school children has been repeatedly raised since the turn of the century. As early as 1913, Terman and Hocking¹ wrote: "Among the important questions which may be raised regarding the sleep of school children are the following: What is the optimum amount of sleep for physical and mental efficiency, and how are we affected by variations above or below this amount?" Already at that time, according to Terman and Hocking, physicians and educators agreed that school children slept less than they should, but disagreed to what extent. In their extensive review of their contemporary literature, they found that views concerning the optimal sleep durations for children of the same age sometimes varied by as much as 2.5 hours. In their own study of sleep habits of 2692 children and young adults in California and Arizona, they found that the average hours of sleep decreased from

11 hours 14 minutes in the 6-7 years age group to 7 hours 47 minutes in university students. Comparison of these data to the average sleep durations of 6180 English children reported by Ravenhill, and to data of 6551 German children reported by Bernhard, showed that American children slept 1 to 1.5 hours more than their European counterparts. Terman and Hocking attempted to explain these disparities by differing life styles, climates, and starting times of schools in Europe and the US. While American children started school at 09:00, Europeans started at 08:00. It is interesting to note that a Japanese study of sleep duration of 5558 school children from approximately the same period, revealed that Japanese school children's sleep duration resembled that of the Americans rather than the Europeans.²

Fifty years later, Anders and his coauthors³ reported on the sleep habits and daytime sleepiness of 218 pre- and early-adolescent school children in a boarding school in Palo Alto. In the 5th grade, although the girls' bedtime was 21:30 and the boys' was 21:00, with significant differences between school and holiday bedtimes, mean sleep time was still 9.5 hours. The authors also reported that daytime

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sleepiness was not a common problem in that age group. Carskadon and her coauthors^{4,5} emphasized the point of reduced sleep hours in adolescents due to environmental factors (social, academic, and peer pressures), and not due to a declining “need” for sleep.

A modern study of cultural differences in sleep habits of school children was reported by Tynjälä et al,⁶ who studied sleep habits, as well as complaints about sleep and other selected health behaviors, of 40,202 11- to 16-year-old Europeans from 11 countries (Austria, Belgium, Finland, Hungary, Israel, Norway, Scotland, Spain, Sweden, Switzerland, and Wales). They reported that sleep habits varied significantly between countries. In all age groups, Israeli pupils reported the shortest duration of sleep, 8.3 hours in 15- to 16-year-olds, 8.6 hours in 13- to 14-year-olds, and 9 hours of sleep in 11- to 12-year-olds. The Swiss children reported the longest duration: 9.2 hours in 15- to 16-year-olds, 9.6 in 13- to 14-year-olds, and 10.0 in 11- to 12-year-olds. Since Israeli pupils’ reported bedtimes were not the latest, it can be concluded that their time of awakening from sleep was the earliest. Tynjälä et al⁶ suggested that further studies on cultural differences in the starting times of schools, the length of the school days, and habits of TV watching should be conducted in order to determine the reasons for the observed differences in the duration of sleep among European countries.

As day breaks in Israel very early during most of the year, activity also starts early: public transportation, government and national offices, and therefore also the education system. Israel is among the few countries where young children (even aged 10 years old) started school very early, around 07:15. Obviously, starting school at this hour requires an even earlier waking time. As has already been suggested by Terman and Hocking, starting times of schools is one of the most important determinants of sleep behavior and may have a profound effect on sleep duration. As bedtime is also dependent upon leisure time habits, and therefore may vary from day to day, the time of awakening from sleep on weekdays is solely dependent on school starting times. The purpose of the present study was to investigate the influence of the school starting hour on sleep duration, as well as on complaints of fatigue and sleepiness among school children in Israel.

METHOD

Subjects

Eight-hundred and eleven 5th grade pupils (10-12 years old), equally divided between the sexes, participated in the study. The pupils were from 28 different classes in 18 schools throughout Israel. School starting times varied between 07:10 and 08:30 (see Table 1 for distribution of starting times). School schedule in Israel is determined by

Table 1.—Starting hour of school

Starting hour	Percent of children
07:10	19.3
07:15	9.4
07:20	10.7
07:30	3.1
08:00	42.0
08:30	15.6

each school individually and there is no uniform regulation. Thus, pupils from the same school, at the same age, or even from the same class, may start and finish school at different hours. Moreover, on different days a class may start one day at 08:00 and finish at 12:00, then on another day start at 07:15 and finish at 13:30. Therefore, schools and classes were chosen for the study without prior knowledge of the starting hour of each class in each school.

As we wanted to compare pupils who started early with pupils who started at a regular time, we chose only those pupils who started at least twice a week at 07:15 or earlier (N=232), and those who started regularly at 08:00 (N=340). Mean age of the 572 pupils was 10.6 (41% aged 10 years, 57% aged 11 years and 2% aged 12 years). There were no significant differences between early and regular risers with respect to age, boys/girls ratio, or geographical area. The remaining 239 pupils started school after 07:15 and before 08:00, or later than 08:00 and were not included in the study.

MATERIALS

We used a self-administered questionnaire that was a composite of parts of several other questionnaires: The Technion Sleep Questionnaire,⁷ The Morningness-Eveningness questionnaire,⁸ and additional questions concerning sleep habits and daytime functioning in school. These included questions related to: sleep habits on school days, weekends and holidays; difficulty in falling asleep, ease of waking up; fatigue and sleepiness during the school day; difficulty in paying attention and concentration at school; and tension with parents due to difficulties in waking up in the morning. Responses to the questions were either “never,” “seldom,” “frequently,” or “all the time.” The questionnaire was formulated as a sleep-habits questionnaire for children and adolescents, without any mention of school starting hours. The validity of the children’s responses was evaluated by comparing children’s and their parents’ answers to the same questions. This comparison

was made on a separate sample of pupils aged 9-18 years (N=406). Significantly high correlations were found between the children's and their parents' answers to the questions concerning sleep habits and sleep times (all correlations were between 0.41 and 0.67).⁹

PROCEDURE

The schools participating in the study were distributed throughout the country, and greatly varied in their pupils population. Some were in large cities, while others were in small villages or agricultural settlements. Permission to participate in the study was granted by the parents. The questionnaires were administered in the classroom by a research assistant who was available to answer any queries. The pupils completed the questionnaires in about 30 minutes. Therefore there were no more than 9% missing answers (for most questions: 3-5%). T-test, ANOVAs or Chi-square analysis were performed when appropriate. Chi-square was done on the absolute number of pupils in each group, but the results are presented in percentages rounded to the nearest whole unit.

RESULTS

There was a significant difference in total sleep time on school days only between the early (07:15) and regular (08:00) risers ($t = 3.58$; $p = 0.0004$) (sleep time was calculated as the difference between the reported bedtime and wake-up time for each pupil) (Fig. 1). Mean sleep time of the early risers was 8.7 ± 1.1 hours on school days, and 9.0 ± 1.9 hours on holidays and weekends, in comparison with 9.1 ± 1.2 and 9.3 ± 2.1 hours for the regular risers (Table 2). The differences between sleep time during school days and holidays/weekends within groups were not significant. There was no difference between the groups with respect to

Table 2.—Mean sleep time of "Early" and "Regular" groups

	School days	Weekends and holidays	N
"Early" group	8.7 ± 1.1	9.0 ± 1.9	232
"Regular" group	9.1 ± 1.2	9.3 ± 2.1	340
t	-3.58	-1.21	
p	0.0004	0.228	

modal lights-off time during weekdays (21:00-22:00: early risers 51%; "regular risers" 53%), nor during weekends and holidays (23:00-24:00; 34% "early risers" vs 31% "regular risers"). Likewise, there was no difference with respect to modal wake-up time which was at 06:00-07:00 (61% - "early group" vs 58% "regular group") on weekdays, and at 08:00-09:00 on weekends and holidays (25% "early group" vs 27% "regular group").

To examine whether early risers compensated on weekends and vacations, we examined the individual differences between sleep time during weekends and vacations and school days in both groups. While most pupils slept longer on weekends, this was not necessarily related to sleep time during school days (Table 3). Thus, in both groups the largest difference between sleep time on weekdays and weekends and vacations was found for pupils reporting 8 hours of sleep during weekdays.

Daytime Complaints

The most notable difference between the "early" and "regular" risers was in the rate of complaints about daytime functioning: On school days, 21% of the pupils who started early complained about being tired throughout the day ("frequently" plus "all the time"), vs 14% of the pupils who started at 0800 ($c2 = 6.2$, $df=1$, $p=0.045$). This difference disappeared on holidays and weekends: 14% vs 12% for early and regular risers, respectively ($c2 = 2.4$, $df=1$, $p=0.3$). Likewise, 12% of the pupils who started early complained about attention and concentration difficulties in school ("frequently" plus "all the time") vs only 7% of the pupils who started at 08:00 ($c2 = 16.3$, $df=1$, $p=0.0001$). Twenty percent of the pupils in the early group reported that they "frequently" or "all the time" had "a feeling of a strong need to sleep during the school day" vs 11% of the "regular" risers ($c2 = 8.17$, $df=1$, $p=0.004$). The two groups also differed with respect to the question: "In which class do you feel most tired?" Fifty percent of the "early risers" felt most tired during the first class starting at 07:10, and only 37% reported on the last class of the day, while 58% of the

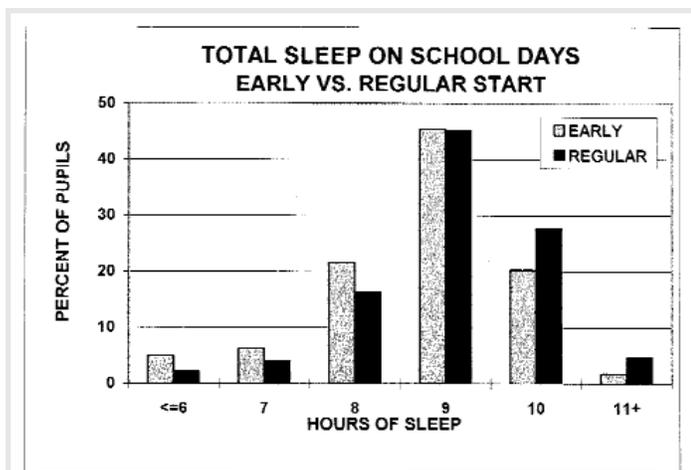


Figure 1.—Total sleep on school days: Early and regular start

Table 3.—Differences between sleep time on weekends and vacations and school days for children reporting different hours of sleep during school days

TST	early risers			regular risers			ALL		
	Mean	N	Std	Mean	N	Std	Mean	N	Std
<=7	0.3	25	2.2	0.5	20	2.0	0.4	45	2.1
8	0.9	49	1.9	0.9	54	2.2	0.9	108	2.0
9	0.3	103	1.5	0.1	150	1.8	0.2	253	1.7
10+	-0.3	50	1.7	-0.2	108	1.9	-0.2	158	1.8

Table 4.—Complaints of concentration, attention difficulties and sleepiness in class (by group)

A. Early risers (07:15)

		Concentration		
		Sometimes	Never	Total
Sleepiness	Sometimes	17% (38)	3% (7)	20% (45)
	Never	41% (91)	39% (85)	80% (176)
	Total	58% (129)	42% (92)	100% (221)

B. Regular risers (08:00)

		Concentration		
		Sometimes	Never	Total
Sleepiness	Sometimes	7% (24)	4% (12)	11% (36)
	Never	35% (113)	54% (179)	89% (292)
	Total	42% (137)	58% (191)	100% (328)

regular risers felt most tired during the last class (after 12:00), although 32% complained about being tired in the first class.

Tables 4A and B present the combined data for the complaints of “difficulty concentrating and paying attention in class” and “a feeling of a strong need to sleep in class” for early and regular risers. This analysis further emphasized the differences between the two groups. The rate of reporting both complaints was two-fold higher in early risers group than in the regular risers (17% vs 7%); likewise, fewer early risers reported “never” having both complaints than did regular risers (39% vs 54%). We compared Table 4A to Table 4B by χ^2 and found that the above differences were significant ($\chi^2=20.23$, $df=3$, $p=0.00015$).

To examine whether the complaints of day time sleepiness and difficulties concentrating and paying attention were related to the hours of sleep, Tables 5A and B compared the reported hours of sleep between the early and regular risers who reported “sleepiness” and “difficulty concentrating and paying attention” either “all the time or fre-

quently,” or “never.” As can be seen, the complaint of sleepiness in the early riser was independent of the reported hours of sleep. It was reported by 26% of the pupils reporting sleeping 7 hours or less during school days, as well as by 21% of the pupils reporting 10 hours or more. The dependency of the complaint on sleep hours appeared to be stronger in the regular risers; it was reported by 20% of those sleeping 7 hours or less, and by 8% to 13% of the rest of the groups. All the differences in percentage of complaints on sleepiness between the children sleeping different hours were not significant in both groups, although (as mentioned before) the early risers complained significantly more of sleepiness (20% vs. 11%).

Table 5b reveals that the complaints of concentration and attention difficulties were independent of sleep hours in both groups. Furthermore, the highest rate of complaints were found in the group reporting 8 hours in the early risers group (65%) and in the group reporting 10 hours or more in regular risers group (94%).

There were no other significant differences between

Table 5.—Sleepiness complaints as a function of sleep time during school days for early and regular risers (by group)

A. Early risers (07:15)

		Reported total sleep time - school days				Total
		<=7	8	9	10+	
Sleepiness	"Sometimes"	26%	18%	20%	21%	20%
	"Never"	74%	82%	80%	79%	80%
	Total (N)	100% (23)	100% (49)	100%(102)	100% (48)	100%(222)

B. Regular risers (08:00)

		Reported total sleep time - School days				Total
		<=7	8	9	10+	
Sleepiness	"Sometimes"	20%	12%	8%	13%	11%
	"Never"	80%	88%	92%	87%	89%
	Total (N)	100%(20)	100%(52)	100%(150)	100%(108)	100%(330)

Table 6.—Concentration complaints as a function of sleep time during school days for early and regular risers.

A. Early risers (07:15)

		Reported total sleep time - school days				Total
		<=7	8	9	10+	
Concentration	"Sometimes"	60%	65%	57%	55%	58%
	"Never"	40%	35%	43%	45%	42%
	Total	100% (25)	100% (48)	100%(103)	100%(49)	100%(225)

B. Regular risers (08:00)

		Total sleep time - school days				Total
		<=7	8	9	10+	
Concentration	"Sometimes"	40%	40%	41%	44%	42%
	"Never"	60%	60%	59%	56%	58%
	Total	100%(20)	100%(53)	100%(147)	100%(111)	100%(331)

the groups. It is interesting to note that in both groups girls slept longer than boys (Table 7), both on school days ($F=9.46$, $df=1,527$, $p=0.002$) and on weekends or holidays ($F=4.94$, $df=1,527$, $p=0.027$).

DISCUSSION

The main findings of the present study were that school children of the 5th grade starting school earlier than usual—at 07:15 or earlier, at least twice a week—slept on

an average 24 minutes less than their counterparts who always started school at 08:00, and complained significantly more of daytime fatigue, sleepiness and concentration difficulties in school.

As noted in the introduction, the question of optimal hours of sleep in school children has been the concern of educators and physicians since the turn of the century. The average sleep duration of our regular risers, who always started school at 08:00 (9 hours), agrees well with the results of the study by Tynjälä et al⁶ that also included

Table 7.—Mean sleep time of boys and girls: early and regular starting times

	School days		Weekends / Holidays	
	Early group	Regular group	Early group	Regular group
Male	8.5 ± 1.2	9.0 ± 1.0	8.7 ± 2.1	9.2 ± 2.1
Female	9.0 ± 1.0	9.2 ± 1.3	9.3 ± 1.7	9.4 ± 2.0
	$F_{1,527}=9.46$	$p = 0.002$	$F_{1,527}=4.94$	$p=0.027$

approximately 1,000 11- to 12-year-old Israeli pupils. As was reported in that comparative study, Israeli pupils reported the shortest sleep durations in all three age groups. A total of 9 hours of sleep is less than the average duration of sleep for similar-aged Japanese, English and American school children investigated at the beginning of the century¹; and 1 and 2 hours less than sleep duration of similar-aged children investigated in our time in the US,¹⁰ Finland,¹¹ and in Belgium.¹² Thus, our findings further confirm that in comparison with other western countries, Israeli school children have relatively short sleep durations.

Notwithstanding, the early riser slept even less. Although the difference between the early risers and the regular risers amounted to only 24 minutes, it should be stressed that in order to avoid bias the questionnaires did specifically address sleep habits during days with early classes, but addressed the issue of sleep habits during school days in general. Had we questioned them specifically regarding sleep on the 2 days when they had an early start, the differences between the groups would most probably have become much larger. This may also explain the fact that we did not find any evidence for larger compensations on weekends and vacations in the early risers.

Most disturbing, waking up earlier than usual at least twice a week was not without negative daytime consequences. The early risers complained significantly more about “being tired during the day,” about “difficulties in concentrating and paying attention during classes,” and had two-fold more complaints about a tendency to doze off in class. These complaints are typical of sleep-deprived subjects, and clearly indicate that the early risers indeed suffered from a mild form of sleep deprivation. The overall rates of complaints in our study are comparable to Blader et al,¹³ who reported a 17% rate of fatigue complaints and 17% of wake-up problems in elementary school children in the USA (aged 5-12). Adolescents (11-15 years old) complained even more,¹⁴ and their complaints increase with age (18% to 35% complained about tiredness). An even more extreme position was raised by Carskadon,¹⁰ who described a chronic pattern of insufficient sleep in adolescents. This could lead to daytime sleepiness, vulnerability to cata-

strophic accidents, mood and behavior problems, increased vulnerability to drugs and alcohol, and development of major disorders of their sleep/wake cycle, as presented also by Tynjälä et al.¹⁴

The observed differences between the early and late risers are also relevant to the ongoing controversy regarding the adequacy of sleep duration in contemporary western societies. The question whether the pace of life in the contemporary world causes sleep deprivation is a matter of heated debate in the literature. Over 20 years ago, Webb and Agnew¹⁵ claimed that most adults suffered from chronic partial sleep deprivation, a claim echoed by Bonnet and Arand¹⁶ in our time. Bonnet and Arand argued that significant sleep loss existed in one third or more of normal adults. In contrast, Harrison and Horne¹⁷ suggested that most people have the capacity to sleep in excess of their physiological needs in the same way as they eat and drink in excess of their caloric requirements. Both proponents have addressed the question of historical changes in sleep time. Webb and Agnew indicated that there was a reduction of about 1.5 hours in total sleep time of children aged 8 to 17 years between the years 1910-11 and 1963, while Harrison and Horne pointed at some inconsistencies between some of the early studies investigating sleep duration in children. Both agree, however, that the advantages of modern life (particularly since television became an integral part of every household) have postponed bedtime until well beyond the fall of darkness. Our results showed that, at least with respect to school children aged 10-11 years, shortening of sleep duration at least twice a week as a result of early school starting time significantly influences daytime behavior. These results provide support to Webb and Agnew’s position that, at least in some segments of the population, chronic sleep deprivation indeed exists and is largely due to a contemporary lifestyle.

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