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Can Later School Time be the Solution to Public Health Problem of Insufficient Sleep in Indian Adolescence?

Deepesh Vaidya[1]*, Archita Joshi Bhatt[2]
[1]*Department of Pulmonology and Sleep Medicine, Health City Cayman Island, East End, Cayman Islands*
[2]*Department of Public Health, Texila American University, George Town, Guyana*
**Corresponding Author: deepesh.vaidya@healthcity.ky*

Abstract

Background: Sleep deprivation in adolescent students is a public health concern. Studies have pointed out that early school start time is an important factor that affects the sleep duration in high school students. This study aims to find out the effect of the later school start time on the adolescent students.

Material and methods: Adolescents studying in class 8th to 10th in the age group of 13-17 years were included in the study. Participate completed questionnaire that include demographic parameters, school start time, ESS score, Sleep wake behavior, sleep duration on weekdays and weekends were recorded using a preformed questionnaire.

Results: 5041 students, including 43.1% (n=2174) female and 56.9% (n=2867) male participated. The total sleep hours on weekdays were only 6.68±0.93 hours, whereas in weekends, their sleep duration was (8.51±1.36). The ESS score was higher in students who had a school start time starting from 7 am - 9 am (8.95±3.11) and who had after 11 am (9.94±2.93). The sleep-wake behavior score is lowest in students who had a school start time above 11 am (24±5.63).

Conclusion: Study indicates that students with later school start time have better sleep wake behavior, less daytime sleepiness and are less sleep deprived.

Keywords: *Later school start time, sleep duration, ESS, adolescent, public health.*

Introduction

Sleep deficiency in adolescents has become a serious public health concern across globe. Reports have suggested that inadequate sleep combined with early school start time is associated with daytime sleepiness among school-going children (1). Adolescence is the period of the rapid development of both physical and psychological health. According to the World Health Organization (WHO), any person who belongs to the age group of 10 years to 19 years can be called as an adolescent. In this phase, all the important neuronal development and changes in the pre-frontal region of the brain take place(2).

In the past, studies have reported that delayed both sleep and rise time can eventually lead to delayed sleep phase. Various factors including some physiological and environmental ones affect the chronic sleep loss in adolescents (3–5). All these sleep restrictions result in several adverse outcomes affecting the quality of life of the young generation and compromising the daytime functioning of the individual. Several studies across the world have shown that inadequate sleep in adolescents is turning into an alarming health issue and start of the school time has a significant effect on adolescent sleep (6).

During the recent past years, the effect of the school start time on adolescent sleep has gained much interest. Studies have pointed out that the effect of school start time affects the learning ability and well-being of the school-going children (6–8). Although several studies have addressed the problem of school start time and its association with sleep deprivation among school-going children, very few studies directly pointed out the problems in adolescents. Hence, this study aims to evaluate whether a later school start time has any effect on the ESS score and the sleep-wake score of the students.

Material and methods

Study participants

This cross-sectional study was conducted in the region of Mumbai and nearby districts of Navi Mumbai, Maharashtra, India. Prior to the initiation of the study ethical clearance was obtained from the institutional ethics committee. The school-going adolescents studying in class 8^{th} to 10^{th} in the age group of 13-17 years living in the study area were included in the study. Administrators of various schools and coaching classes were contacted. Aim, objective, and importance of the study were explained and an institution that were willing to participate were provided with consent forms to be distributed in class to get parental consent. Consent was also taken from students taking part in the study

Inclusion criteria

- Students studying in the 8^{th} standard to 10^{th} standard who were willing to participate in this study were included.

Exclusion criteria

- Unwilling participants were excluded.
- Parents who did not give consent were also excluded.

Study tools

Excessive daytime sleepiness was assessed using the Epworth Sleepiness Scale (ESS) for children and adolescents (9). This scale evaluates excessive daytime sleepiness in individuals. In this scale 1 indicates lower chances of dozing, 2 moderate, and 3 severe chances of dozing. In addition, few more questions were included to find out excessive daytime sleeping in adolescences. Question number 24 of Teen Sleep Habit survey questionnaire was taken to assess sleep wake behavior in school (17). Moreover, few questions were also included about School start time, School end time, Time they go to bed, their sleep time, wake time (to calculate number of hours sleep they get during week night and weekends).

Study protocol

An online survey was designed in survey monkey and was shared with various institutions to get it filled from their students. After the permission was obtained from the schools, questionnaire was distributed among the students. The chief investigator went to each class and explained the study in detail to students and their various question were answered. A tabulated question was including finding out their sleep-wake behaviors in school. The demographic parameters including, age, gender, and other details were also calculated.

Statistical analysis

The data was entered and tabulated in Microsoft Excel. After the tabulation was complete it was analyzed using SPSS software (version 21.0). The descriptive statistics data were calculated as mean ± standard deviation. Pearson's chi-square test was conducted for deduction of significance and a p-value<0.05 was regarded as statistically significant.

Results

In this study total, 5041 students were included in which 43.1%was female (n=2174), and 56.9% were male participants (n=2867) (Table 1, Figure 1).

Table 1. Gender distribution of the study participants

Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	2174	43.1	43.1	43.1
	Male	2867	56.9	56.9	100.0
	Total	5041	100.0	100.0	

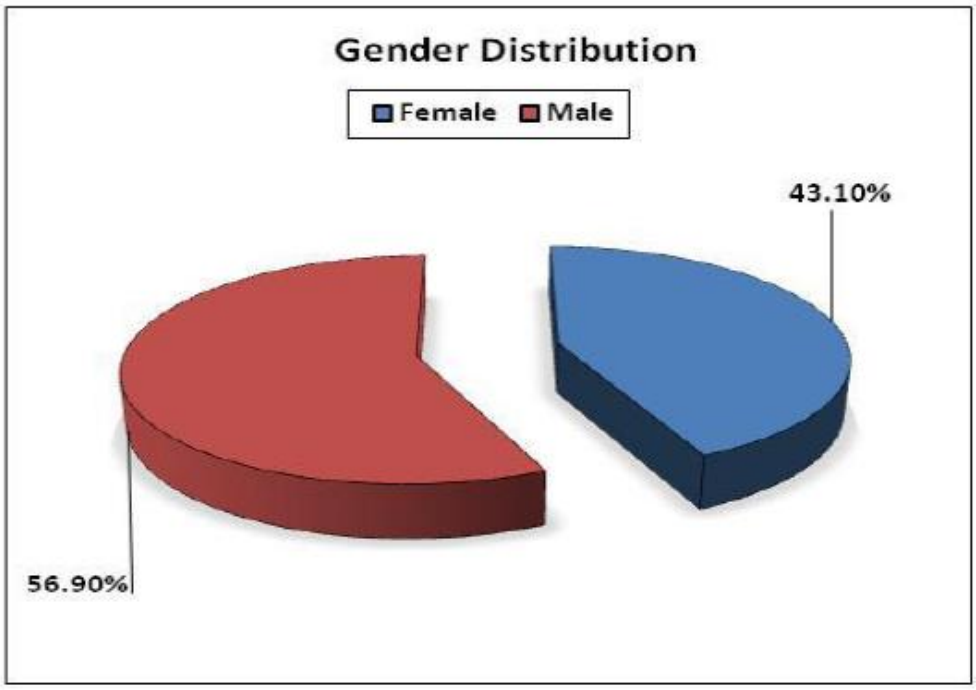

Figure 1. Gender Distribution

The maximum of the students was studying in the 10th standard (n=2237, 44.4%), followed by 9th standard (n=1828, 36.3%) and 8th standard (n=976, 19.4%) (Table2).

Table 2. school years among study participants

Studying year					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	8	976	19.4	19.4	19.4
	9	1828	36.3	36.3	55.6
	10	2237	44.4	44.4	100.0
	Total	5041	100.0	100.0	

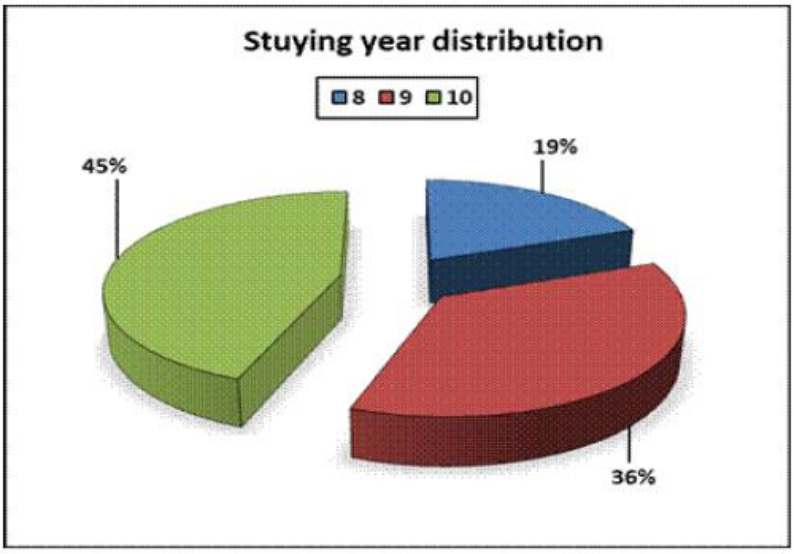

Figure 2. School years distribution

The total sleep hours on weekdays were only 6.68±0.93 hours. In contrast on weekends, students reported a much longer sleep duration (8.51±1.36) (Table 3). On statistical analysis, the study participants showed a positive correlation between Total Sleep hours on weekdays and Total Sleep hours on weekends, while correlation is negative between Total Sleep hours on weekdays and ESS Score (Table 3).

Table 3. Total sleep hours and ESS score on weekdays and weekends

Summary statistics					
Variable	Observations	Minimum	Maximum	Mean	Std. deviation
ESS Score	5041	0.00	24.00	8.94	3.12
Total Sleep hours on weekdays	5041	1.17	11.25	6.68	0.93
Total Sleep hours on weekends	5041	2.50	14.00	8.51	1.36

Statistical analysis of total sleep hours in weekdays and weekends

Model parameters						
Source	Value	Standard error	t	P-value	The lower bound (95%)	Upper bound (95%)
Intercept	9.14	0.38	23.93	< 0.0001	8.39	9.89
Total Sleep hrs on weekdays	-0.06	0.05	-1.15	0.25	-0.15	0.04
Total Sleep hrs on the weekend	0.02	0.03	0.59	0.55	-0.05	0.09

Correlation matrix			
Variables	**Total Sleep hours on weekdays**	**Total Sleep hours on weekends**	**ESS Score**
Total Sleep hours on weekdays	**1.00**	0.23	-0.01
Total Sleep hours on weekends	0.23	**1.00**	0.00
ESS Score	-0.01	0.00	**1.00**

There is very less effect of Total Sleep hrs on weekdays / Total Sleep hrs on weekends on ESS Score (Table 4).

Table 4. Total sleep hours and ESS score

Regression of variable ESS Score				
Variables	Variables	MSE	R^2	Adj.R^2
2	Total Sleep hours on weekdays / Total Sleep hours on weekends	9.76	0.0003	**-0.0001**

There is very less effect of Total Sleep hours on weekdays / Total Sleep hours on weekends on Sleep-wake in school Score (Table 5).

Table 5. Sleep time effect on wake behavior

Summary statistics					
Variable	Observations	Minimum	Maximum	Mean	Std. deviation
Sleep-wake in school Score	5041	13.00	56.00	28.14	5.96
Total Sleep hours on weekdays	5041	1.17	11.25	6.68	0.93
Total Sleep hours on weekends	5041	2.50	14.00	8.51	1.36

Correlation matrix			
Variables	Total Sleep hours on weekdays	Total Sleep hours on a weeknight	Sleep-wake in school Score
Total Sleep hours on weekdays	1.0000	0.2315	-0.0714
Total Sleep hours on weekends	0.2315	1.0000	-0.0138
Sleep-wake in school Score	-0.0714	-0.0138	1.0000

Regression of variable Sleep-wake in school Score				
Variables	Variables	MSE	R^2	Adj.R^2
2	Total Sleep hours on weekdays / Total Sleep hours on weekends	35.3082	0.0051	0.0047

Analysis of variance					
Source	DF	Sum of squares	Mean squares	F	Pr > F
Model	2	912.38	456.19	12.92	< 0.0001
Error	5038	177882.58	35.31		
Corrected Total	5040	178794.96			
Computed against model Y=Mean(Y)					

Model parameters						
Source	Value	Standard error	t	Pr > |t|	The lower bound (95%)	Upper bound (95%)
Intercept	31.13	0.73	42.84	< 0.0001	29.70	32.55
Total Sleep hours on weekdays	-0.46	0.09	-4.99	< 0.0001	-0.65	-0.28
Total Sleep hours on weekends	0.01	0.06	0.20	0.84	-0.11	0.14

Maximum students who took part in this survey showed a school starts time starting from 7 am to 9 am (n=4946). Only 14 participants had a school start time starting from 9 am to 11 am. 19 participants reported that they have an afternoon shift school start time starting after 11 am. The ESS score was higher in students who had a school start time starting from 7 am - 9 am (8.95±3.11) and who had after 11 am (9.94±2.93). The sleep-wake behavior score is lowest in students who had a school start time above 11 am (24±5.63) (Table 6). Figure 3 shows that students who have a school start time from 9 am to 11 am showed a better sleep wake behavior and lower ESS score indicating lower daytime sleepiness and better sleep duration compared with the other students with a morning school start time.

Table 6. Correlation of ESS Score and Sleep-wake behavior score on the school start time

School start time	Total	ESS Score		Sleep-wake behavior score	
		Mean	SD	Mean	SD
Before 7 am	62	7.59	3.02	26.19	7.03
7am-9am	4946	8.95	3.11	28.18	5.92
9am-11am	14	7.57	3.47	29.14	6.61
Above 11 am	19	9.94	2.93	24	5.63

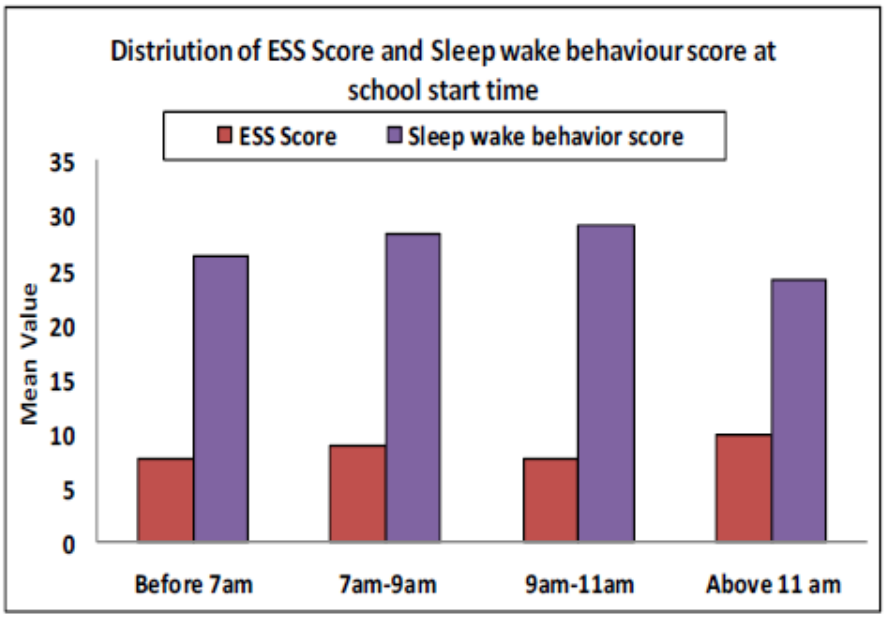

Figure 3. Correlation of ESS Score and Sleep-wake behavior score on the school start time

Discussion

Previous studies have pointed out that approximately 9 to 9.5 hours of sleep is required for the health and proper functioning of adolescents. Based on empirical evidence the American Academy of Pediatrics recommends that 13 years to 18 years old individuals should regularly sleep for at least 8 to 10 hours at night(8). However, several factors along with early school start time result in chronic sleep restrictions in this population. Despite these recommendations in maximum cases students studying in the middle and higher school sleeps less than 8 hours per night resulting in decreased school grades (10).

In the present study, the effect of the school start time on adolescent sleep and ESS score was evaluated. The present study showed that in weekday's adolescents gets a lower sleep time compared with the weekends. Several studies across the world have reported variable results. In a study conducted in different European countries, ***Sarchiapone et al (2014)*** have reported that average sleep duration in adolescents is 7.7 hours (11). In another study conducted in the USA among adolescents in the age group of 15 to 18 years, it was reported that 68.5% of people had a sleep duration of fewer than 8 hours. This study also pointed out that sleep duration of fewer than 5 hours can less likely result in negative outcomes in this population (12).

In the present study, it was shown that early school start time results in decreasing ESS scores. Interestingly, it was also observed that even students who have a school start time after 11 am also have a higher ESS score. It was previously described that both longer and shorter sleep duration can eventually lead to excessive daytime sleepiness(13). ***Carskadon et al (1998)*** first reported that early school start time increases daytime sleepiness. This study also pointed out that early school start time is associated with approximately 20 minutes of less sleep and an increase in daytime sleepiness (14).

In a study conducted in Brazil among 11,525 students, it was reported that morning school shifts and short sleep duration are associated with daytime sleepiness. This study has also reported that ESS score is higher in students who have shorter and longer sleep duration (13).Sleep debt among adolescents has become a major public health issue. Globally, a large number of schools started using this later school start system to address sleep deficiency in adolescents. Although there are several other factors related to sleep debt in adolescents, the possibility of intervention in school start time can have a direct effect.

In another study conducted by Hansen et al (2005) it was reported that students usually feel less alert in the morning classes. However, when they join afternoon classes, they feel less sleepy. They also reported that early morning is a

difficult time for students to remember complicated study material (15).

It is well documented in several studies that learning is well connected with memory which is again dependent on good sleep. In a study by Smith, the correlation between sleep, memory, and learning abilities were discussed. It was also mentioned by the author that learning a motor task is a type of procedural material and this type of material is sensitive to loss of sleep (16).

It is unfortunate that still this public health burden is unrecognized by most of the educators. A change in policy is warranted in this aspect that can evaluate the effect of school start time and its relation with the sleep debt in adolescents.

Conclusion

This study indicates that sleep deprivation and daytime sleepiness are common among students studying in higher classes in and around Mumbai. Most of the schools have an early morning start time and that significantly affects the sleep duration of the students. This study also indicates that students who have later school start time, have better sleep wake behavior, lower daytime sleepiness and are less sleep deprived. Unfortunately, most of the schools have an early morning start time and that significantly affects the sleep duration of the students. Hence later school start time can be implemented in the school curriculum to address this public health issue of sleep deprivation among Indian adolescence.

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Conflicts of interest

There are no conflicts of interest.

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