

Impact of Delaying School Timing on Sleep of Adolescent Students

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Abstract

Purpose: Across the world sleep profile of human population has changed due to modern life style. With the adaption of this life style, the sleep wake patterns of adolescents have also changed. The sleep durations of these group has reduced due to delayed bed timing and early school timing leading to chronic sleep deprivation which is accumulating as sleep debt. Higher sleep debt has been implicated for various health problems and reduction in academic performance. In earlier work, delaying of school timing by one or two hours has been proposed to reduce the sleep loss and improve the sleep quality of adolescent students. Therefore, this study was planned to evaluate the impact of delaying the school start timings by one hour on the sleep behavior of adolescent students by taking 3 different school start timings.

Methods: The present study includes randomly selected healthy boys and girls of 7th and 8th class from 3 different schools with 3 different school start timings 7:30 am, 8:30 am, and 10:00 am. With the consent of school authorities and parents the Epworth Sleepiness Scale (ESS) (Johns 1991) and Munich chronotype questionnaire was administered to evaluate sleep profile. In the questionnaire, questions related to the sleep wake pattern of students and their general biographical information were also included to study their sleep behavior.

Results: Average sleep of the students studying in early school start timing (7:30 am), was found to be significantly less than the students of 8:30 am and 10:00 am schools with higher sleep debt, more sleep latency and increased sleepiness level during daytime. Statistical tools also revealed that the sleep debt has heightened positive correlation with excessive daytime sleepiness and sleep latency among early school timing students.

Conclusions: The findings of the present investigation clearly suggest that delaying of early school start timing by 1 hour will increase the sleep duration of these sleep deprived individuals with reduction in sleep debt and sleep latency. Further, an hour of delaying school timing will also helps to overcome excessive daytime sleepiness level and improvement of sleep quality with betterment of mental, physical health and academic performance of students.

Keywords: Adolescent, early school timing, sleep debt, mental health improvement.

INTRODUCTION

Sleep is a biological necessity of human for healthy and productive life. Sleep requirement varies among individuals of different age groups. The sleep need of adolescent is higher than the adults and at least 9 hours sleep per night has been recommended for their healthy living. Insufficient sleep leads to sleep

deprivation and has been shown to cause several diseases such as obesity [1-3], diabetes [4], Neurological disorders [5], asthma [6], arthritis [7], and heart diseases [8]. In the recent past this biological need has been compromised for modern living style of human populations especially among urban dwellers [9-11, 3] including adolescent students [12,2] with a reduction in sleep duration across the world. This lack of sleep accumulates day by day and cause sleep deficit or sleep debt which is the difference between the amount of sleep needs and the amount of sleep they actually get. Under chronic sleep deprivations, higher accumulation of sleep debt results in weight gain [13], increase anger [14], increase social isolation [15], negative thinking [16], metabolic alterations, cardiovascular diseases [17] and type 2 diabetes [18] in adolescents. Prolonged sleep deprivation has also been implicated for impairment of memory and cognitive functions of adolescents and young adults. Adolescent students who do not get sufficient sleep have problems of not paying proper attention and poor academic performance [19-21]. Several factors, such as combination of late bedtimes and early rise time [22,2], increase in school work, participation in after school activities, late night use of mobile phones and laptop in bedroom [23-25] and biological changes during this puberty period have been attributed for insufficient sleep of adolescent's students. Besides this, pressure for maintaining academic performance has also been reported for delaying their bed time and sleep deprivation [26]. As the delayed bed timing and early school start timings leads to sleep deprivation with accumulation of sleep debt in adolescents, delaying the morning school start timings by 1 or 2h has been recommended for the adolescent students to increase their sleep duration [2]. However this hypothesis was based on two school timings i.e 7:30 am and 11:00 am only. In present study, 3 different school start timings that is 7:30 am, 8:30 am and 10:00 am have been taken to assess the impact of delaying the early school start timings by one hour on the sleep behavior of adolescent students.

Materials and Methods

A preliminary survey was carried out for selection of schools. Suitable urban middle schools having school start timing at 7.30 am, 8:30am and 10:30 am were selected for this study. The objectives of the study were explained and necessary permission was obtained from the school authorities for conducting the study. Consent from the participating students was also obtained. The study was targeted upon the students of class 7th and 8th with age groups ≥ 12 years and ≤ 14 years. Students taking medication or having any type of health related problems were excluded from this study. Randomly selected 196 students studying in 7:30 am school timing (88 boys and 108 girls), 88 students of 8:30 am school timing (37 boys and 51 girls) and 287 students of 10:30 am school timing (182 boys and 105 girls) participated in the study. Sleep behaviour and sleepiness level of these middle school students was measured by utilizing Epworth Sleepiness Scale (ESS) and sleep debt of the participating students was determined by administering Munich chronotype questionnaire.

The Questionnaires were explained and necessary instruction were also given to the participants before responding the questions. Questionnaires were distributed to the participants and completely filled questionnaires were collected back from them by one of the author. Questionnaires included biographical information, sleep habits (bed time and wakeup time) during weekdays and weekends, time spent on bed before the actual onset of sleep (sleep latency) and their health status.

Epworth sleepiness scale was used to measure sleepiness level among students. Students having ESS score of 10 or more were categorize as suffering from excessive daytime sleepiness. For the measurement of sleep debt (weekly) Munich chronotype questionnaire was used which includes bed time, wakeup time, sleep latency and sleep onset timings on both weekdays and weekends.

All the statistical analysis was done by SPSS software (version 16 for windows). ANOVA test was performed to determine variances in different groups. Correlation and regression was done to study the association between different parameters involved in present study.

RESULT:

Mean and standard deviation of various sleep variables in 3 different school timings have been summarized in table 1. Sleep debt of the students as a function of gender in all the school timings has been given in table 2. Correlation between sleep debt and different sleep variables of the students studying in three different school start timings both during weekdays and weekends have been summarized in table 3.

SLEEP DURATION

The mean sleep duration (weekdays) of students having school start timing 7:30 am was found to be 6.8 ± 0.02 h, school start timing from 8:30 am was 8.5 ± 0.06 h and that of school start timing from 10:00 am was found to be 8.7 ± 0.03 h. During weekends sleep duration of 7:30 am school students was found to be 8.71 ± 0.06 h, 8:30 am students was 9.1 ± 0.09 h and that of 10:00 am students was 9.8 ± 0.05 h. It was clearly seen that students having 7:30 am school timing has significantly ($p < 0.001$) lower sleep duration than 8:30 and 10:00 am school timing students (Table 1).

BEDTIME

During weekdays the mean bed timings of 7:30 am school students was found to be $9:20 \pm 0.02$ pm, 8:30 am school timing students was $10:06 \pm 0.06$ pm and that of 10:00 am school timing students was $10:14 \pm 0.03$ pm. In weekends the bed timings of 7:30 am, 8:30 am and 10:00 am school timing students was found to be $10:42 \pm 0.03$ pm, $10:38 \pm 0.05$ pm and $10:31 \pm 0.03$ pm respectively (Table 1). There was a significant ($p < 0.001$) difference found between weekday bedtimings of students in 3 different school timings but in the weekends no significant difference was observed.

WAKETIME

Wake up time in weekdays of 7:30 am school timing students was found to be $5:27 \pm 0.02$ am, 8:30 am school timing students was $7:00 \pm 0.06$ am and that of 10:00 am school timing students was $7:12 \pm 0.04$ am. Similarly, during weekends the wakeup time of 7:30 am, 8:30 am and 10:00 am school timing students are $7:15 \pm 0.06$ am, $7:45 \pm 0.08$ am and $7:41 \pm 0.05$ am respectively. The difference between wakeup time of different school timing students in weekdays was found to be significant ($p > 0.001$). Sleep wake schedule of the students studying in 8:30 am and 10:00 am is almost similar.

SLEEP LATENCY

The mean sleep latency of the students during weekdays of 7:30 am, 8:30 am and 10:00 am students were recorded as 16.7 ± 0.07 min, 15.0 ± 0.01 min and 13.1 ± 0.00 min respectively. During weekend, mean sleep latency of 7:30 am, 8:30 am and 10:00 am was found as 23.0 ± 0.01 min, 21.7 ± 0.01 min and 19.4 ± 0.00 min respectively. Weekday sleep latency of 7:30 am school start timing students was higher than other school timing students. Statistical analysis of data through ANOVA revealed a significant difference in the sleep latency as a functions of school timings ($p < 0.024$) (Table 1). Analysis of data also revealed that sleep latency is positively associated with sleep debt (figure 6).

SLEEPINESS LEVEL (ESS score)

Assessment of sleepiness level among school students was done by utilizing Epworth Sleepiness Scale (ESS Score). The mean ESS score of 7:30 am students was found to be 12.22 ± 0.18 , 8:30 am students was 11.73 ± 0.28 and 10:00 am students was 8.67 ± 0.20 . When the data was subjected for two-way ANOVA, the ESS score was found to be significantly ($p = 0.038$) vary as a function of school timings (Table 1). The

prevalence of excessive day time sleepiness (EDS) among the students of 7:30 am school, 8:30 am school and of 10:00 am school was found to be 47%, 30% and 26% respectively. It was also observed that the ESS score was found to be more in girls than the boys irrespective of school start timings (Table 2).

TIME SPEND ON ENTERTAINMENT

The average time spending on entertainment by the students of 7:30 am school start timing was 2.1 ± 0.05 h, 8:30 am students was found to be which was found to be 2.0 ± 0.09 h and 10:00 am was found as 1.7 ± 0.05 . The mean values of the time spent on entertainment of students in all the school timings shows significant relation with each other ($p < 0.001$) (Table 1).

SLEEP DEBT

The mean sleep debt of 7:30 am, 8:30 am and 10:00 am school timing students was found to be 1hour11 minutes, 35 minutes and 47 minutes respectively. ANOVA test revealed a significant variation ($p < 0.001$) of sleep debt between 3 different school timings (Table1). In figure 1 it seems that 7:30 am school students are having higher sleep debt than 8:30 am and 10:00 am students. The relation between sleep debt and sleep duration in different school timing have been given in table 3. Further, sleep debt of students shows a significant negative correlation with their weekdays sleep duration and wakeup timing irrespective of shift (figure 2 and 5). Whereas, weekdays bed timing and sleep latency was found to have significant positive correlation with sleep debt in all the studied school timings (figure 3 and table 3). Similarly, ESS score also shows a positive correlation with sleep debt in all shifts (figure 6 and table 3). It was also found that female students have more sleep debt than male students irrespective of the school timings as shown in table 2.

DISCUSSION:

Adolescence is a crucial time of life characterized by several important developmental changes [27-28] with a higher sleep requirement than adults and other age group with optimum sleep of 8-10 hours per night. Although adolescent sleep have been reported to be influenced by several factors [29], school timing has been found as major contributor for sleep deprivation among these group in a number of studies [30-38,2]. Hence delaying of school timing by one or two hours has been proposed for improvement of adolescent's sleep [2]. However, this study was based on two school timings only.

In the present study, besides early morning and evening school a morning school with one hour delayed school start timing was also included to validate the impact of delaying school timing. Comparison of sleep durations in three school start timings, 7:30 am, 8:30 am and 10:00 am revealed that, the sleep duration of the students studying in 7:30 am school is significantly less than the students of other two schools. Further comparison of sleep durations amongst the students of these three school start timings also revealed that the sleep duration of the students studying in either 8:30 am timing or 10:00 am is almost two hours more than the early start timing. Which clearly suggest that delaying of school start timing can bring about a noticeable positive change in the sleep behavior of students with significant increases of almost two hours sleep, with delaying of school start timing by one hour. Measurement of excessive daytime sleepiness revealed that the average sleepiness score of 7:30 am school students were is significantly higher (12.22 ± 0.185) than other two school timings. Further, it was also noticed that delaying of school start timings by one hour, not only increases the sleep durations of students but also reduce sleepiness level of these students. Analysis of data indicate that delaying the school start timing by one hour increasing the bedtime of students leading to increase in sleep duration with drastic reduction of sleep debt. The sleep debt of early morning school timing (7.30 am) is significantly higher (1h 11 min) than

8:30 am (35 min) and 10:00 am (47 min) school students. Prevalence of sleep debt is also higher among this group of students (69%) as compared 8:30 (35.2%) and 10 am (20.6%). Results suggest that 1 hour delay of school timing is sufficient to reduce sleep debt by 50% in the population. Occurrence of higher sleep debt among female students irrespective of school timings may be because of physiological changes during puberty among female students. A shorter sleep time result in increase of sleep latency [39]. The mean sleep latency of a normal adult is considered in between 10 and 20 mins [40]. Statistical analysis of data shows positive correlations between sleep latency and sleep debt suggesting a chronic sleep deprivation in early morning school start timing students. Computations of sleep debt as function of entertainment gadgets shows an inverse relation with number of hours spent on these gadgets. The present study also suggests a clear association between sleep duration and the number of hours spent on these entertainment modes in all group of students.

Keeping in view the findings of the present study, it can be concluded that early school start timing contributes in shorter sleep duration of students and this chronic sleep deprivation is accumulated as sleep debt among students. Therefore, delaying of school start timing, at least for one hour, of these adolescent students can be adapted as an effective strategy for increasing sleep duration to overcome from excessive daytime sleepiness, sleep latency and reduce sleep debt to improve sleep quality for the betterment of student's health and increase their academic performance.

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