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Sleep Difference between Adolescents and Young Adults

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Authors' contributions

This work was carried out in collaboration among all authors. The idea of study was conceived by authors SR and SM. Authors SM and PV have jointly conducted the study. Initial draft of manuscript was written by authors PV and SR. Final draft of manuscript was prepared by authors SR, SM and PV. Statistical analysis was done by authors PV and RD. All authors read and approved the final manuscript.

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ABSTRACT

Background: Sleep is important for maintaining overall physical and mental health. Adolescents and young adults (AYAs) at growing age need more sleep because it acts as the fuel for rapidly growing brain and bodies. Many physicians encounter young people having health issue developed due to improper sleep. Understanding the connection between sleep and health in AYAs is important as the sleep problem is coming up as a global pandemic that can seriously harm the health, safety, productivity of our nation's young generation, thus, is a major public health concern.
Aim: The current study investigates the sleep behavior (such as sleep onset, sleep offset, sleep latency, sleep inertia, actual sleep) of adolescents in comparison to young adults.
Methods: Present study is based on self-reported sleep-log entries made by subjects. The collection of data is done on a random basis from school and university set up. Sleep log sheet is an instrument that elicits sleep-related data (sleep onset/offset, latency/inertia, etc.) on a day-to-day basis. Statistical analysis was done using the Mann-Whitney U test at a significance level of $p < 0.005$.

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Results: To conduct this study, individuals of two different age groups were selected; adolescent group (age = 14±01 year; n = 564) and young adult (age = 23±01 year; n = 43). The study shows a significant difference between adolescents and young adult's timings for various sleep variables such as time to bed (*p<0.0001),* sleep onset *(p<0.0001)*, sleep offset (*p<0.0001),* sleep inertia *(p= 0.0156*). Although, no significant difference was reported in actual sleep duration and sleep latency between the groups.

Conclusion: Outcomes of the study are indicative of sleep deprivation in adolescent students. This information can help us to further understand the sleep-related differences in the behavior of adolescent and young adults. This can aid in devise a better work schedule to optimize their performance.

Keywords: Adolescents; young adults; sleep-wake cycle; sleep log; sleep onset/offset; sleep latency/inertia; actual sleep.

1. INTRODUCTION

Sleep is a complex interplay between circadian rhythms and homeostatic drive in animal physiology. It is directly related to human health and plays a pivotal role in many processes of life such as growth, memory and learning [1], immunity [2]. It keeps changing through different life-history stages. Human life has different life-history stages broadly categorized as childhood (newborn, infant and child), adolescent (early and late adolescence) and adulthood (young, mid and old adult). Although, its consolidation takes place in the first 6 months of life. Generally, it sets with the major activity period synced with the day and rests in the night in form of nocturnal sleep [3]. Each stage shows different requirements of sleep hours e.g., adolescents require approx. 9 hours of sleep [4,5] and adults about 7.5 hours of consolidated sleep [6].

Out of these, adolescence is the intermediate period between child and adulthood. Changes taking place during this phase are rapid and creates turbulence both in the physiology and psychology of an individual. Meanwhile, the thrust of the public health sector is focused on development and improvement in health care of either infants or adults but the adolescent population has majorly remained the left-outs [7-8]. When we step ahead, to understand the adolescent circadian clock and sleep behavior, in light of their physiological demand and the consequences of daily sleep deprivation for attending school in early hours, gives a new angle to address adolescent behavior.

World Health Organization (WHO) defines adolescent and young adults as a group of individuals between 10 to 24 years of age. This age represents the development and maturation of the body and rapid changes in the brain and behaviors [9]. Any change in the sleep duration is linked with advance/delay in sleep-wake timings. Delay in going to bed and sleep onset becomes more prominent in adolescents [4]. This change in sleep cyclicity during adolescence is accompanied by the change in chronotype [10]. Chronotype during adolescence shifts towards evening type roughly from 13 years of age and continues to shift during adolescence (showing its peak around 17-20 years), after that it again starts reversing back to morning-type in adulthood [11-12]. Thus, adolescents are known for the delay in their going to bed timings and this lateness is most prominent in older adolescents [13]. The probable reason for this transformation could be the change occurring in the process that regulates sleep physiology i.e., inherent circadian clock system and homeostatic drive for sleep [14]. On one end the physiology does not allow adolescents to sleep early at night and on the other edge, social timings do not allow them to remain slept till late in the morning hours, thus creating overall sleep deprivation in them. This pattern is very prominent during the secondary school years of life [13].

Studies also suggest that sleep-related issues at an early age (adolescent or young adulthood) may lead to chronic sleep problems in older ages. In one such study, prediction of adulthood sleep problems was done based on, adolescence sleep pattern [15]. It is speculated that if at the age of 16 a group of people are suffering from sleep-related problems then 1/3rd will suffer from the same at the age of 23 and out of those, approx. 10% of people will continue to suffer by 42 years of age. In the health care system, adolescents generally meet physicians for issues that somewhere have connections with fatigue or poor sleep. In such cases, if the

physician is unable to identify and consider sleep as the underlying problem then, the treatment would not be able to cure the disease. Another situation can also be considered as the case reverse of the former, as a sleep-related problem may hint at some major health issues such as hypertension, CVDs, obesity, type 2 diabetes, colorectal cancer and many other metabolic syndromes.

There is a high need to understand sleep in the young generation because current social conditions are swiftly under transformation from traditional to modern lifestyles. The duration between adolescents and young adulthood is very small and less surveyed, therefore, we found it interesting to investigate the difference in the sleep-wake pattern in the two groups of students, adolescents (the beginners) the adults (younger ones), if any.

2. METHODS

2.1 Design

The study uses all the data from sleep diary entries. The entries were made by subjects based on their self-observation. Student volunteers were selected from a local school and university. Based on age, adolescents were majorly taken from standard 9th whereas young adults were from M.Sc. class from the university.

2.2 Subject and Sampling

Subjects were divided into two groups on the basis of age. The volunteers who opted for the study were more in adolescent group (age = 14±01 year; n = 564) but relatively less in young adult (age = 23±01 year; n = 43). Adolescent students were from secondary school and young adults were from university set up in Lucknow (26.85º N, 80.95º E latitude), Uttar Pradesh, India. The healthy volunteers (without any history of neurological, psychological or physiological disease) were selected for this study and were duly informed about the method, purpose and type of research work involved in it. They were given full freedom to discontinue being part of the study at any point in time and were assured of anonymity and secrecy of their data.

2.3 Variables and Instruments

The main instrument to study subjective sleep in the current study is the sleep log sheet. The Sleep diary/log is a commonly accepted/validated method to study sleep-related behaviors [16]. The sleep log elicits sleep-wake time along with related parameters. This can be used for short as well as long term studies. In the present study, the entry of one sleep-wake cycle per subject on an ordinary working day was taken.

In the sleep log, volunteers were asked to fill their time to bed, time to sleep/ sleep onset, time to wake up/ sleep offset, time to leave the bed. To calculate actual sleep (AS) duration we took the difference between sleep offset (SOff) and sleep onset (SOn), total time in bed (TTIB) is the difference between the time to leave the bed (TTLB) and time to bed (TTB), sleep latency and inertia are calculated from the difference between sleep onset – time to bed (SOn – TTB) and time to leave bed – sleep offset (TTLB – SOff), respectively.

2.4 Data Analysis

Sleep logs after being filled by the participants were assigned a code for anonymity and then entered all the data in an Excel spreadsheet. Data are shown as mean±SEM. Normal distribution was tested using the Kolmogorov-Smirnov test in which none of our data sets was found to be normally distributed. Mean and SEM of adolescent and young adult groups were compared using the Mann-Whitney U test. A significance level of $p < 0.005$ was considered as a significant difference. The statistical analysis was done using IBM SPSS version 20 and Graph Pad Prism Software version 5.0, San Diego, USA.

3. RESULTS

Results are reported from the analysis of sleep-log showing a difference in sleep behaviors of adolescent and young adults. The sleep log is comprised of various sleep parameters such as time to bed, sleep onset, Sleep offset, and time to leave the bed, and difficulty in getting up.

1) Time to bed (TTB) and Sleep Onset (SOn): Adolescents were early to bed (TTB: A= 2249.22 ±3.38; YA= 2431.02±20.35; *p<0.0001*) and thus their sleep onset was also early in comparison to young adults (SOn: A= 2282.71±3.78; YA= 2464.05±20.23; *p<0.0001; Mann-Whitney U test; Fig. 1).*

2) Sleep offset (SOff) and Time to leave the bed (TTLB): Just opposite to the pattern of their TTB and SOn, adolescents have both their sleep offset (SOff: A= 0579.90±4.88; YA= 0720.47±15.19; *p<0.0001*) and time to leave the bed (TTLB: A= 0598.29±4.94; YA= 0742.53±15.80; *p< 0.0001; Mann-Whitney*

U test; Fig. 2) later than those of the young adults.

3) Sleep latency (SL) and Sleep inertia (SI): No difference in latency but slight difference was found in sleep inertia (SI: A= 0.18±0.01; YA= 0.22±0.02; *p= 0.0156; Mann-Whitney U test; Fig. 3*).

4) Actual Sleep (AS): Total amount of sleep taken is more in early adolescents whereas less in their young adults (A= 697.19±5.63; YA= 656.42±15.29; *p= ns*; *Mann-Whitney U test; Fig. 4*).

4. DISCUSSION

In the current study, we examined the variation in sleep-wake pattern between two life-history stages on the brims of biological and social change (one school-going adolescent and the other of university going young adults). Results from our study are indicative of sleep debt in school-aged adolescents.

Adolescents went to bed in advance (p<0.0001; approx. 1 hr 50 minutes) than the young adults and thus, the sleep onset is in proper sync with the time to bed (TTB: A= 2249.22±3.38; YA= 2431.02±20.35, SOn: A= 2282.71±3.78; YA= 2464.05±20.23, Fig. 1). These results are in line with another study done on adolescents, which revealed that the majority of high-school students went to bed before midnight (around 2200 hr) which was delayed with an increase in their age and class standard [17-19].

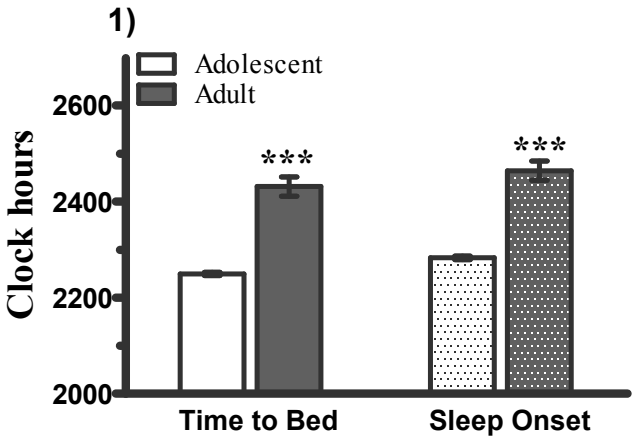

Fig. 1. Time to bed and sleep onset
Asterisk (***) shows a high level of significance that is reported from the Mann-Whitney U test at p<0.005

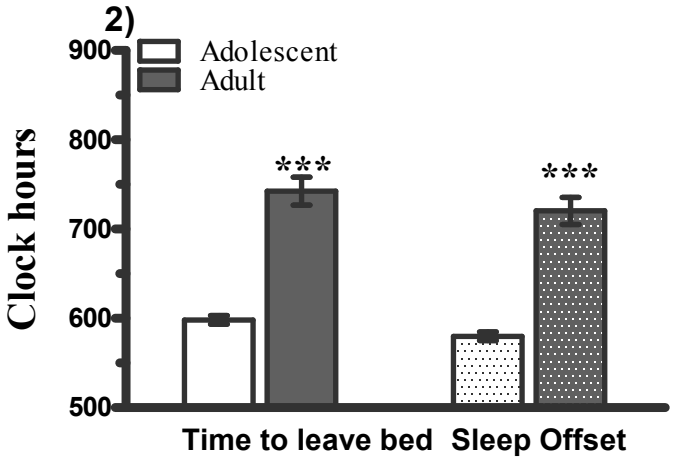

Fig. 2. Time to leave the bed and sleep offset
Asterisk (***) shows a high level of significance that is reported from the Mann-Whitney U test at p<0.005

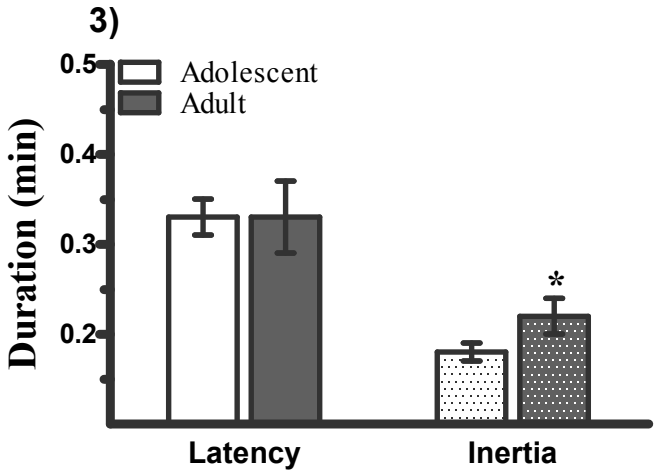

Fig. 3. Sleep latency and Sleep inertia
Asterisk (*) shows a low level of significance that is reported from the Mann-Whitney U test at p<0.005

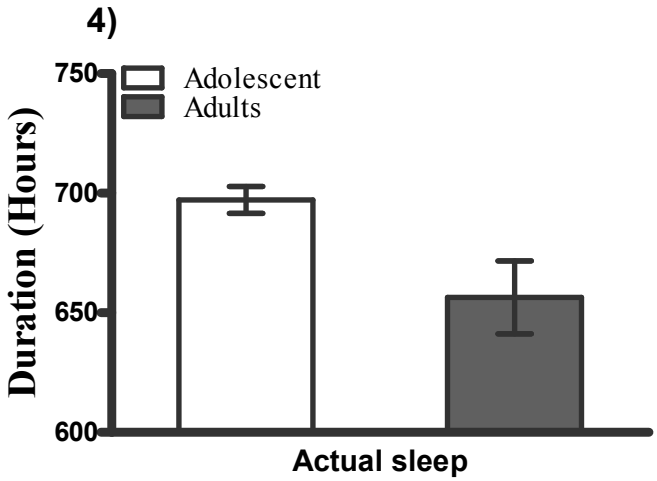

Fig. 4. Actual sleep
No significant difference in between both the groups' p= ns; Significance is reported from the Mann-Whitney U test at p<0.005

Following the trend of sleep onset, offset of sleep and TTLB was also found to be earlier ($p<0.0001$; approx. 1 hr 25 minutes) in adolescents in comparison to young adults (SOff: A= 0579.90±4.88; YA= 0720.47±15.19, TTLB: A= 0598.29±4.94; YA= 0742.53±15.80, Fig. 2). This shows the adolescents are under tough social regimen and parental guidance due to which they have to reach their beds by 10:30 p.m and get up early in the morning (as per their school start time) whereas young adults have autonomy over their sleep-wake timings [20-22]. This behavior in young adults can be backed-up with a study conducted on adults (both young and old) in which, younger adults chose afternoon or evening slots for doing any physical and mental tasks whereas older counterparts have chosen the morning time schedules [23]. This study can be understood in connectivity to sleep-wake time of young adults from the current study where lateness is evident in their sleep behavior.

Sleep latency has shown no significant difference between the groups but young adults have significantly more inertia than adolescents.

Although, mean sleep duration in adolescents was slightly longer compared to YAs (A= 697.19±5.63; YA= 656.42±15.29; with no significant difference) the actual sleep in both the groups was found to be less than the required amount. This trend itself explains the quantity of social pressure this younger generation is suffering from. This can be justified by looking at their morning routines. Adolescents have to rush for school in the early hours of the morning whereas YAs have a slightly flexible routine which gives them a chance to leave the bed according to their comfort [24-26]. There is evidence from the studies in support of our finding in which adolescents face sleep deprivation during school days [27-28]. Another study on Indian teenagers revealed that they are sleeping on an average of 6.61 hours during school days [29] which is far less than the recommendation of the duration of sleep i.e., 8-10 hours by NSF (National Sleep Foundation) [30]. Indian adolescent sleep duration is even shorter than the average sleep duration of adolescents estimated from different countries of the world [29,31-32]. Our study explains the inadequate amount of adolescent sleep duration of secondary school students. It has also been reported that Asian adolescents sleep for a shorter duration than their American and European age alike individuals [5]. Sleep deprivation in adolescents leads to stress, fatigue and daytime sleepiness [33] and damaging the cognitive abilities of a person [34-35]. It also compromises the quality of sleep in adolescents [36]. The duration of adolescence is very small and full of rapid changes. There is a need for a detailed examination of the socio-behavioral aspects of their life. Our findings will help to understand the sleep-pattern and task performance in adolescents.

5. RECOMMENDATIONS AND LIMITATIONS

Sleep plays a key role in maintaining the health and wellbeing of adolescents and young adults. Insufficient sleep has posed a variety of adverse effects on the population. Such studies can help in bringing sensitization among the population. The use of basic screening methods such as sleep logs helps in enhancing the understanding of sleep monitoring in the day today, as well as clinical routine procedures. Although further investigations using other questionnaires, actigraphy and psychometric analysis are also required in the field. There are some inherent challenges in establishing a conclusion with conventional sleep log-based analyses.

6. CONCLUSION

Sleep has an important role to play in the health of adolescents and young adults, both in the short and longer-term. The current piece of work focuses on the difference in sleep behavior in the early stages of both adolescent and adulthood. Our study is indicative of the prevalence of sleep debt in adolescents. Sleep loss is associated with physiological and psychological problems in the later life of an individual. It is need of the hour that negotiating daily tasks with the sleep duration should be stopped and thus, it is highly recommended to adjust the school start hours with the physiological demands of the students. We suggest conducting counselling of school authorities, parents and students to adopt proper sleep habits and to reduce sleep loss in this age group. This will help to build up a health workforce for the future.

CONSENT

As per ICMR guidelines and Institutional Ethics Committee, University of Lucknow, the written consent of the volunteers has been collected and preserved by the author(s). They gave their written consent in a prescribed format.

ETHICAL APPROVAL

The Institutional Ethics Committee of the University of Lucknow has approved the study protocol (LU/IEC/ZOOL/2019/5/01).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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