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Influence of Sleep Patterns on Blood Pressure among Senior Secondary Students of CBSE Schools in Haridwar City

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ABSTRACT

Background

Sleep pattern is an important determinant of adolescent health and physiological functioning. Inadequate sleep duration and poor sleep quality may influence cardiovascular parameters, particularly blood pressure. Senior secondary students often experience changes in sleep habits due to academic demands, technological exposure, and lifestyle factors. Therefore, the present study examined the influence of sleep patterns on blood pressure among senior secondary students of CBSE schools in Haridwar City.

Methods

A cross-sectional study was conducted on 200 senior secondary students, comprising 110 boys and 90 girls, selected through a multistage sampling technique. Sleep pattern data were collected using a structured questionnaire prepared by the researcher. Blood pressure was measured using a digital blood pressure monitor and recorded on a blood pressure observation sheet prepared by the researcher. The collected data were analysed using appropriate statistical techniques to examine the relationship between sleep patterns and blood pressure.

Results

The average sleep duration of the participants was 7.27 ± 0.93 hours per night, with 67.5% of students sleeping less than 8 hours and 6.0% sleeping less than 6 hours. Poor sleep patterns were observed among 36.0% of the participants. The mean systolic and diastolic blood pressures of the participants were 113.88 ± 6.11 mmHg and 73.69 ± 3.78 mmHg, respectively. Students with poor sleep patterns demonstrated higher systolic (116.25 mmHg) and diastolic (75.19 mmHg) blood pressure values than students with moderate and good sleep patterns.

Conclusion

The study concluded that a considerable proportion of senior secondary students experienced inadequate sleep and poor sleep habits. Students with poor sleep patterns demonstrated relatively

higher blood pressure values, suggesting a possible association between sleep behaviour and blood pressure among adolescents. The findings highlight the importance of promoting healthy sleep habits to support cardiovascular health among school-going students.

Keywords: Sleep Pattern, Blood Pressure, Adolescents, Senior Secondary Students, CBSE Schools, Haridwar City.

INTRODUCTION

Sleep is a fundamental physiological process essential for growth, development, restoration, and overall health. During adolescence, adequate sleep plays a critical role in physical maturation, cognitive functioning, emotional regulation, memory consolidation, and academic achievement. The quality and duration of sleep significantly influence the well-being of adolescents and contribute to their longterm health outcomes.ⁱ

Adolescence is characterised by substantial biological, psychological, and social changes that often affect sleeping habits. In recent decades, researchers have observed a decline in sleep duration among adolescents worldwide. Increasing academic demands, extracurricular activities, changing lifestyles, and technological advancements have contributed to irregular sleep schedules and inadequate sleep among school-going students.ⁱⁱ

The rapid expansion of digital technology has further influenced adolescent sleep behaviour. Excessive use of electronic devices such as smartphones, computers, television, and social media platforms has been associated with delayed bedtime, shorter sleep duration, and poor sleep quality. These behaviours disrupt normal sleep patterns and may result in excessive daytime sleepiness, reduced concentration, and impaired academic performance.ⁱⁱⁱ

Sleep hygiene refers to behavioural and environmental practices that promote healthy and restorative sleep. Positive sleep hygiene practices include maintaining a regular sleep schedule, engaging in adequate physical activity, and avoiding stimulating activities before bedtime. Conversely, poor sleep hygiene behaviours such as late-night screen exposure, irregular sleeping hours, heavy meals before sleep, and inadequate physical activity have been linked with sleep disturbances among adolescents.^{iv} A study conducted among adolescent schoolgoers in Tamil Nadu reported a high prevalence of inadequate sleep duration, poor sleep hygiene practices, and excessive daytime sleepiness, highlighting the growing concern regarding adolescent sleep health in India.^v

Beyond its influence on cognitive and behavioural outcomes, sleep has important implications for cardiovascular health. Sleep deprivation and poor-quality sleep can activate the sympathetic nervous system, increase stress hormone secretion, and alter metabolic functioning. These physiological changes may contribute to elevated blood pressure and increase the risk of future cardiovascular disorders.^{vi} Research has demonstrated that adolescents experiencing poor sleep quality are more likely to exhibit higher blood pressure levels and other cardiovascular risk factors.^{vii}

Recent evidence suggests that inadequate sleep duration, poor sleep quality, and irregular sleep patterns may adversely affect cardiovascular functioning during adolescence. Sleep deprivation

has been associated with increased sympathetic nervous system activity, hormonal imbalance, elevated stress responses, and disturbances in blood pressure regulation. Adolescents experiencing insufficient sleep are more likely to develop cardiovascular risk factors, including elevated blood pressure, obesity, and metabolic abnormalities. Since blood pressure patterns established during adolescence often persist into adulthood, understanding the relationship between sleep patterns and blood pressure has become an important area of public health research.^{vi, vii}

Blood pressure is a vital indicator of cardiovascular health and reflects the force exerted by circulating blood against arterial walls. Although hypertension is often considered an adult health problem, recent evidence suggests an increasing prevalence of elevated blood pressure among adolescents. Lifestyle factors such as physical inactivity, obesity, unhealthy dietary habits, psychological stress, and insufficient sleep have emerged as important determinants of blood pressure during adolescence.^{viii}

In India, senior secondary school students frequently experience academic stress, examination pressure, prolonged study hours, and increased screen exposure, all of which may negatively influence sleep behaviour. Since both sleep disturbances and elevated blood pressure can adversely affect adolescent health, understanding their relationship is of considerable importance. Although several studies have examined sleep-related issues among adolescents, limited research has specifically investigated the influence of sleep patterns on blood pressure among senior secondary students of CBSE schools in Haridwar City.

Therefore, the present study aims to examine the influence of sleep patterns on blood pressure among senior secondary students of CBSE schools in Haridwar City. The study seeks to determine whether variations in sleep duration, sleep quality, and sleep-related behaviours are associated with differences in blood pressure levels among adolescents. The findings of the study may contribute to a better understanding of adolescent health and provide valuable insights for educators, parents, healthcare professionals, and policymakers in promoting healthy sleep behaviours and cardiovascular well-being among school-going students.

Methodology

Participants

The present study was conducted on senior secondary students studying in Classes XI and XII of CBSE schools in Haridwar City. Students enrolled in the selected schools and willing to participate in the study were considered eligible for inclusion. The final sample consisted of 200 students, comprising 110 boys and 90 girls.

Sampling Method

A multistage sampling technique was employed for the selection of participants. Five CBSE schools were shortlisted from different areas of Haridwar City. To ensure adequate representation of the target population, students from both urban and rural backgrounds were included in the study. Efforts were made to cover different parts of the district so that the sample reflected the characteristics of the broader senior secondary student population. Approximately 40 students were selected from each of the five schools, including about 22 boys and 18 girls from each school.

Study Instrument

Sleep Pattern Questionnaire

Data related to sleep patterns were collected using a structured questionnaire prepared by the researcher. The questionnaire included items related to age, gender, class, average sleep duration, reasons for disturbed sleep, and perceived sleep pattern. The information obtained through the questionnaire was used to assess the sleep habits and sleep-related characteristics of the participants.

Blood Pressure Observation Sheet

Blood pressure was measured using a digital blood pressure monitor and recorded on a blood pressure observation sheet prepared by the researcher. Prior to measurement, participants were asked to sit comfortably and rest for a few minutes. Both systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured and recorded in millimetres of mercury (mmHg).

Data Collection Procedure

Data were collected during scheduled visits to the selected schools. The purpose of the study was explained to the participants before administration of the questionnaire. Information regarding sleep patterns was collected using the structured questionnaire, while blood pressure measurements were recorded separately on the observation sheet under standardised conditions.

Statistical Analysis

The collected data were recorded, tabulated, and analysed using appropriate statistical techniques. Descriptive statistics such as frequency, percentage, mean, and standard deviation were used to summarise the data. The analysis was carried out to examine the influence of sleep patterns on blood pressure among senior secondary students.

Ethical Considerations

Participation in the study was voluntary. The purpose of the study was explained to all participants prior to data collection. Confidentiality of the information provided by the participants was maintained throughout the study, and the collected data were used solely for research purposes.

Results

A total of 200 senior secondary students participated in the study. The participants were selected from five CBSE schools of Haridwar City, representing both urban and rural backgrounds. The collected data were analysed to examine sleep patterns and blood pressure among the participants.

Distribution of Participants

To understand the characteristics of the study sample, the participants were categorised according to age, gender, and class. The distribution of participants is presented in Table 1.

Table 1

Distribution of Participants according to Age, Gender and Class

<i>Variable Category</i>		<i>Frequency</i>	<i>Percentage (%)</i>
<i>Gender</i>	Boys	110	55.0
	Girls	90	45.0

Class	XI	92	46.0
	XII	108	54.0
Age	16 yrs	58	29.0
	17 yrs	96	48.0
	18 yrs	46	23.0

Interpretation

Table 1 presents the distribution of participants according to age, gender, and class. Out of 200 students, 110 (55.0%) were boys and 90 (45.0%) were girls.

Among them, 92 students (46.0%) belonged to Class XI and 108 students (54.0%) belonged to Class XII. The majority of the participants were 17 years of age (48.0%), followed by 16 years (29.0%) and 18 years (23.0%).

Sleep Duration of Participants

Sleep duration is an important indicator of sleep behaviour among adolescents. The average sleep duration of the participants was assessed and categorised into different groups. The distribution of participants according to sleep duration is presented in Table 2.

Table 2

Distribution of Participants according to Average Sleep Duration

Sleep Duration (Hours)	Frequency	Percentage (%)
Less than 6 hours	12	6.0
6 – 8 Hours	123	61.6
More than 8 Hours	65	32.5
Total	200	100.0

Interpretation

Table 2 presents the distribution of participants according to average sleep duration. The mean sleep duration of the participants was found to be **7.27 ± 0.93 hours per night**. Among the participants, **61.5% reported sleeping between 6 and 8 hours**, while **32.5% slept for more than 8 hours per night**. A small proportion of students (**6.0%**) reported sleeping for less than 6 hours. The findings indicate variation in sleep duration among the participants, with the majority reporting sleep durations below the recommended eight hours per night.

Sleep Pattern Classification

To assess the quality of sleep among the participants, sleep patterns were classified into poor, moderate, and good categories. The distribution of participants according to sleep pattern classification is presented in Table 3.

Table 3

Classification of Participants according to Sleep Pattern

Sleep Pattern	Frequency	Percentage (%)
Poor	72	36.0
Moderate	66	33.0

Good	62	31.0
Total	200	100.0

Interpretation

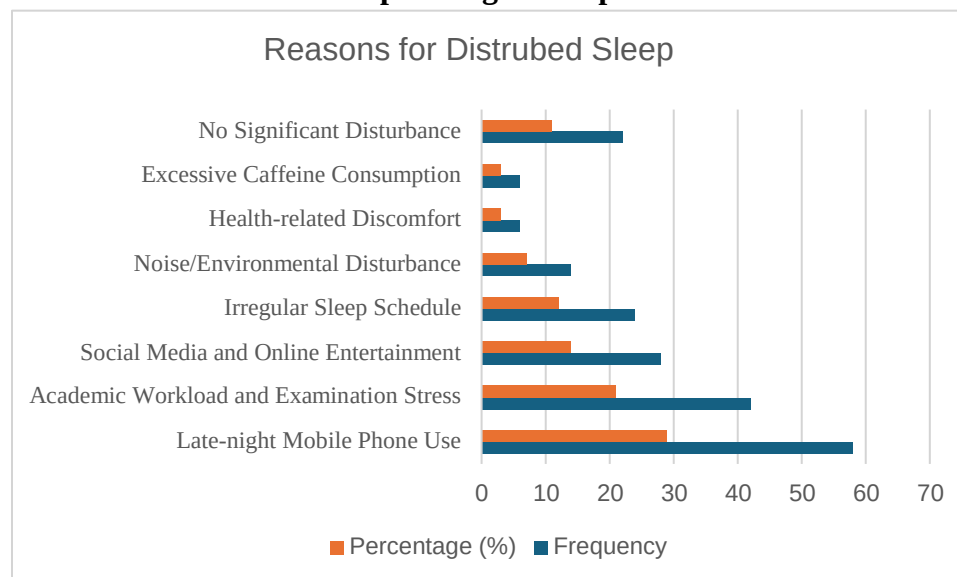
Table 3 presents the classification of participants according to their sleep patterns. Among the participants, 72 students (36.0%) were categorised as having poor sleep patterns, 66 students (33.0%) as having moderate sleep patterns, and 62 students (31.0%) as having good sleep patterns. Poor sleep patterns were found to be slightly more prevalent than moderate and good sleep patterns.

Reasons for Disturbed Sleep

Various factors contributing to disturbed sleep were reported by the participants. These factors were analysed to identify the most common causes of sleep disturbance among senior secondary students. The findings are presented in Figure 1.

Figure 1: Horizontal Bar Graph

Reasons for Disturbed Sleep among Participants



Interpretation

Figure 1 illustrates the reasons reported by participants for disturbed sleep. Latenight mobile phone use (29.0%) emerged as the most commonly reported reason, followed by academic workload and examination stress (21.0%), social media and online entertainment usage (14.0%), and irregular sleep schedules (12.0%). A smaller proportion of students reported noise or environmental disturbances (7.0%), health-related discomfort (3.0%), and excessive caffeine consumption (3.0%) as contributing factors. Furthermore, 11.0% of the participants reported no significant sleep disturbance.

Blood Pressure according to Sleep Pattern

To examine the influence of sleep patterns on blood pressure, the mean systolic and diastolic blood pressure values were compared across different sleep pattern categories. The results are presented in Table 4.

Table 4

Blood Pressure of Participants according to Sleep Patterns.

Sleep Pattern	Mean SBP (mmHg)	Mean DBP (mmHg)
Poor	116.25	75.19
Moderate	112.32	72.44
Good	112.77	73.26
Overall Mean	113.88 ± 6.11	73.69 ± 3.78

Interpretation

Table 4 presents the blood pressure values of participants according to sleep pattern classification. The mean Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) of the participants were 113.88 ± 6.11 mmHg and 73.69 ± 3.78 mmHg, respectively. Students with poor sleep patterns demonstrated higher blood pressure values (SBP = 116.25 mmHg; DBP = 75.19 mmHg) compared with students having moderate sleep patterns (SBP = 112.32 mmHg; DBP = 72.44 mmHg) and good sleep patterns (SBP = 112.77 mmHg; DBP = 73.26 mmHg).

Summary of Findings

The findings revealed that a substantial proportion of senior secondary students experienced inadequate sleep duration and poor sleep patterns. Late-night mobile phone use and academic stress emerged as the major factors associated with disturbed sleep. Students classified as having poor sleep patterns exhibited higher systolic and diastolic blood pressure values compared with those having moderate and good sleep patterns.

Discussion

Sleep Pattern among Senior Secondary Students

The findings of the present study revealed that a considerable proportion of senior secondary students experienced inadequate sleep duration and poor sleep patterns. The average sleep duration of the participants was 7.27 ± 0.93 hours per night, and a substantial proportion of the students reported sleeping for less than the recommended duration of sleep. Furthermore, 36.0% of the participants were categorised as having poor sleep patterns. These findings indicate that inadequate sleep remains a common concern among adolescents and may have important implications for their health and well-being.

The findings are consistent with those reported by Owens et al., who observed that insufficient sleep has become increasingly prevalent among adolescents and is associated with adverse physical, emotional, and academic outcomes.^{ix} Similar observations were reported by Owens, who highlighted that modern adolescents frequently experience inadequate sleep due to behavioural, environmental, and lifestyle-related factors.^x

The findings may be particularly relevant in the context of Haridwar City, where senior secondary students often face academic pressures associated with board examinations and preparation for higher education. Such demands may contribute to irregular sleep schedules and reduced sleep duration among adolescents.

Factors Associated with Disturbed Sleep

The present study identified late-night mobile phone use as the most commonly reported reason for disturbed sleep among the participants, followed by academic workload and examination stress. Social media use, online entertainment, and irregular sleep schedules were also reported as important contributors to disturbed sleep.

These findings are supported by Hale and Guan, who reported that screen-based activities are consistently associated with shorter sleep duration, delayed bedtimes, and poorer sleep quality among children and adolescents.^{xi} Similarly, He et al. found that increased screen time is significantly associated with adverse sleep outcomes, particularly among adolescents exposed to prolonged digital media use.^{xii}

The prominence of academic workload and examination stress observed in the present study may be attributed to the demanding nature of senior secondary education. The combined influence of academic demands and increasing dependence on digital devices may contribute to delayed bedtimes, reduced sleep duration, and poorer sleep quality among adolescents.

Influence of Sleep Patterns on Blood Pressure

The findings of the present study revealed that students categorised as having poor sleep patterns demonstrated higher systolic and diastolic blood pressure values compared with students having moderate and good sleep patterns. Students with poor sleep patterns recorded mean blood pressure values of 116.25 mmHg systolic and 75.19 mmHg diastolic, whereas comparatively lower values were observed among students with moderate and good sleep patterns.

The findings are in agreement with the study conducted by Javaheri et al., who reported that poor sleep quality was associated with elevated blood pressure and an increased risk of pre-hypertension among healthy adolescents.^{vii} Similar findings were reported by Mullington et al., who suggested that sleep deprivation may adversely affect cardiovascular regulation through alterations in autonomic nervous system activity and hormonal mechanisms.^{vi}

Further support is provided by dos Santos et al., who reported a significant association between shorter sleep duration and elevated blood pressure among adolescents.^{xiii} The comparatively higher blood pressure values observed among students with poor sleep patterns in the present study are therefore consistent with previous evidence emphasising the importance of healthy sleep habits for cardiovascular health.

Although the present findings indicate a relationship between sleep patterns and blood pressure, the cross-sectional nature of the study does not permit conclusions regarding causality. Further longitudinal investigations involving larger and more diverse samples are required to establish the direction and strength of this relationship.

Conclusion

The present study examined the influence of sleep patterns on blood pressure among senior secondary students of CBSE schools in Haridwar City. The findings revealed that a considerable proportion of students experienced inadequate sleep duration and poor sleep patterns. Late-night mobile phone use, academic workload, examination stress, and social media usage emerged as the major factors associated with disturbed sleep among the participants.

The study further revealed that students with poor sleep patterns demonstrated comparatively higher systolic and diastolic blood pressure values than those with moderate and good sleep patterns. These findings suggest that healthy sleep habits may play an important role in maintaining cardiovascular health and overall well-being among adolescents. Therefore, promoting adequate sleep and healthy sleep practices among senior secondary students may contribute to better health outcomes.

Recommendations

The findings of the present study highlight the need to promote healthy sleep habits among senior secondary students. Schools should organise sleep awareness and health education programmes to educate students about the importance of adequate sleep and proper sleep hygiene. Students should be encouraged to maintain regular sleep schedules and limit the use of mobile phones and other electronic devices before bedtime. Parents and teachers should work collaboratively to monitor sleep-related behaviours and create a supportive environment that promotes healthy sleep practices. In addition, schools may introduce stress management programmes and counselling services to help students cope with academic pressure and examination-related stress. Regular health assessments, including blood pressure monitoring, may also be conducted to identify potential health concerns among adolescents at an early stage.

Limitations of the Study

The present study was limited to 200 senior secondary students selected from CBSE schools in Haridwar City; therefore, the findings may not be generalised to students studying in other educational boards or geographical regions. Information related to sleep patterns was obtained through self-reported responses, which may be subject to response bias. Furthermore, the study adopted a cross-sectional research design, which does not permit the establishment of causal relationships between sleep patterns and blood pressure. The study also focused primarily on sleep-related variables and did not examine other factors that may influence blood pressure, such as physical activity, dietary habits, socioeconomic status, and psychological conditions.

Conflicts of Interest: None Declared

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