P-ISSN: 2394-1685
E-ISSN: 2394-1693
Impact Factor (RJIF): 5.93
IJPESH 2025; 12(5): 362-369

https://www.kheljournal.com
Received: 05-07-2025
Accepted: 09-08-2025

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Correlation between screen time, sleep duration and body mass index in school going children - A cross-sectional study

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DOI: http://doi.org/10.22271/kheljournal.2025.v12.i5f.4002

Abstract
Background: Obesity among children and adolescents has emerged as a major global health issue in recent years. The relationship between body mass index, screen time, and sleep length was found to have both good and negative effects on school-age children.
Objectives: To determine the correlation between Body mass index, Screen time, Sleep duration.
Method: In this cross-sectional study, school-age children's BMI, screen time, and sleep length were examined. 62 students in all participated in this study. A non-parametric test was employed to determine correlation because the data was not regularly distributed. Analysis and Spearman's rho correlation test were performed.
Results: As the data was not normally distributed, a non-parametric test was used for correlations between BMI and screen time shows p value >0.05 (0.105) and r value -208. BMI and sleep duration shows p value 0.05 (0.085) and r value -221 is obtained; spearman's rho test was used.
Conclusion: Mild negative correlation has been found between BMI-Screen time, and Screen time-Sleep duration, and mild positive correlation between BMI-sleep duration in school going children but it was not statistically significant. Mild negative correlation has been found between BMI Screen time and Screen time-Sleep duration.

Keywords: BMI, screen time, sleep duration

Introduction
Excessive sedentary behavior is associated with poor health and can result in increased adiposity, worse cardio metabolic health and fitness, impaired behavioral conduct/pro-social behavior, and reduced sleep duration. For children, several current physical activity guidelines recommend recreational screen time of no more than 2h per day (i.e., watching television [TV], digital video discs, or videos, playing TV games, or using computers or the internet) and avoiding prolonged periods of sitting. Nevertheless, children spend too much time on their recreational screen time worldwide [1]. The interplay of genetic and behavioral factors, such as unhealthy lifestyle habits, can lead to an increase in non-communicable disorders, including cancer, type 2 diabetes, hypertension, dyslipidemia, and osteoarthritis, as well as other chronic or degenerative diseases. Among these, obesity is particularly widespread on a global scale, resulting in an epidemic. According to some estimates, the annual burden of disease imposed by high Body Mass Index (BMI) Obesity represents an urgent issue that needs to be properly addressed, especially among children [2]. Parents play an essential role in children's daily decision-making through modeling, rules or restrictions, social support, and co-participation. Previous review studies have shown that parents' screen time is positively correlated with children's screen time, and co-viewing with parents has been associated with increased screen time in children [1].

What is BMI
BMI is the ratio of an individual's height in meters (m) and weight in kilograms (kg), from which body mass index (BMI, kg/m^2) was calculated, and it is used to estimate a person's risk of weight-related health problems. BMI measures excess body weight for a particular height. It

is not a direct measure of body fat but has been shown to correlate with body fat. BMI is the most widely used measure of weight-related health risk because direct measures of body fat (e.g., skinfold measures, underwater weighing) are more invasive and costly. BMI is a screening tool to assess obesity [3]. High Body-Mass Index (BMI) has become one of the biggest public health problems worldwide in the last two decades. A BMI over 25kg/m^2 in the general population represents a risk factor for cardiovascular, metabolic, and musculoskeletal diseases. The population of young adults is at extreme risk, since it goes through lifestyle changes in terms of extensive electronic media use and academic demands, which can potentially lead to insufficient sleep and poor sleep quality, often accompanied by poor diet and lack of physical activity [4].

BMI results in children and adolescents need to be interpreted with caution because height, weight, bone mass, and percent body fat change at different times and rates during the growth spurts that characterize child development, especially puberty. For example, boys who are more advanced in their sexual maturity have less body fat than other boys with a similar BMI; whereas more mature girls have higher body fat levels than other girls [3] A low body mass index (BMI) is associated with increased mortality and low health-related quality of life [5].

Table 1: Obesity classification [5]

Obesity Classification	WHO (BMI)	Asia-Pacific (BMI)
Underweight	≤18.5	≤18.5
Normal	18.5–24.9	18.5–22.9
Overweight	25–29.9	23–24.9
Obese	≥30	≥25

Obesity is currently regarded as a public health problem that affects both children's as well as adults. The onset of obesity may occur at any age, and is triggered by factors such as early weaning, inadequate food intake, eating disorders, and problems related to family relationships, especially during growth spurts. In the last decades, children have become less active as a result of their easy access to technological advances. A positive relationship has been observed between lack of activity (e.g., time spent watching television) and an increase in adiposity in school-aged children. Physical activity, however, reduces the risk of obesity by regulating the energy balance or improving the ratio of lean-to-fat tissue [6]. Parenting style, which provides family principles and routines, may influence children's behavior. For example, limiting TV viewing time reduces screen time, family meals improve diet quality and reduce time spent in front of the TV, and parental participation and support in physical activity increase children's physical activity levels [7].

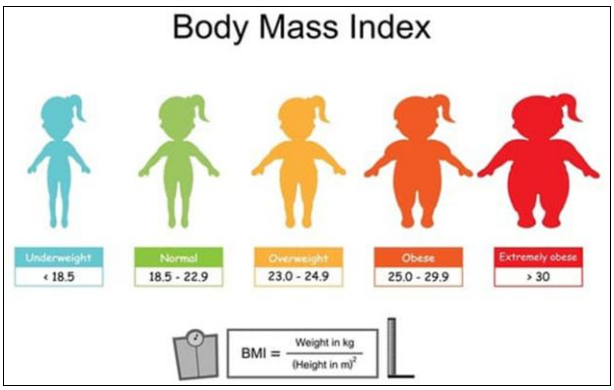


Fig 1: Body mass index

Sedentary behaviors including watching TV, playing video games, and sitting in front of computers are common among kids and teenagers. Sedentary behavior raises the risk of obesity by one hour each hour and contributes to the failure of many attempts by children and teenagers to lose weight. Less than two hours of screen time should be allowed each day because the reverse is linked to greater weight status and increased adiposity [5].

Screen time

The term "screen time" describes the amount of time spent on electronic or digital media devices, including computers, smartphones, tablets, and televisions. Smart gadgets like smartphones, tablets, and laptops are becoming more and more common in daily life, business, and education as science and technology advance and become more interwoven into social interactions. Children are spending more time in front of screens and are being exposed to electronic devices at an earlier age. Excessive screen usage might harm kids' physical and emotional well-being. Schools are among the public institutions that have used a variety of lockdown protocols. There are now more elementary and middle schools offering online instruction, and school-age children are spending more time using electronic devices for online education. The impact of extended screen time on school-aged children's physical and mental health is more evident and permanent than that of adults because of their stage of physical development [8].

Sedentary behavior was identified via screen viewing. After calculating the average daily screen time, it was categorized as "without prolonged screen time (viewing screen < 2 h/day)". or "with extended screen time (using a screen for more than two hours per day)"[9]. The amount of time spent watching screens was determined by adding up all of the media use that was either a primary or secondary activity during the weekday. This included the time-use estimates (in minutes) for watching TV, playing video games, and using a computer, laptop, or tablet, which were measured using time-use diaries from yesterday and tomorrow [10].

The evolving obesity pandemic has been attributed in large part to changes in lifestyle. Children today might spend more time on electronic media than on any other activity besides sleeping. The simultaneous use of televisions, personal computers, smartphones, and game consoles frequently promotes sedentary behavior. Furthermore, it has been discovered that a major factor influencing the amount of time spent on screens is the sharp rise in the availability of electronic media in children's bedrooms. Furthermore, it has been demonstrated that viewing TV and using a computer are linked to shorter sleep durations [11].

Effects of screen time on the development of children

For young children, preschoolers, school-aged children, and toddlers, television and technology have become an essential aspect of their life. In the current generation, every home has digital gadgets including computers, TVs, cell phones, tablets, and digital toys. In their early infancy, parents are introducing their young children to mobile devices and other smart devices through video communication in order to connect with friends and family who live far away. While parents and siblings watch television, babies are exposed to background television. Media and other gadgets can occasionally be used by parents and other adults to help children relax. Today's kids are growing up with smart devices and mobile phones in both home and school environments [12].

The amount of hours a child typically spends watching TV

(including videos) each day was one way to get information on screen time.

Spends time on a computer (PC) separately on weekdays and weekends, playing games (apart from homework) at home or elsewhere [11].

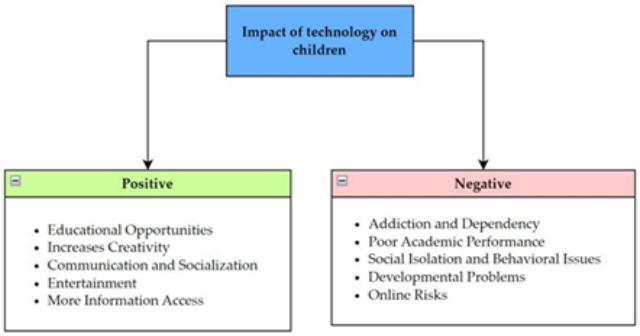


Fig 2: Children's use of technology can have both positive and negative effects [12]

The most recent developments in artificial intelligence can have a variety of effects on young children as well. Young, imaginative minds can be stimulated by realistic picture generating models like DALL-E, and language models like ChatGPT can assist kids in learning and writing perfect essays. Educational materials, like interactive applications and instructional films, can help kids of all ages acquire new skills both at home and at school. Kids connect and chat with peers on social media sites like Instagram, Facebook, and TikTok. The use of social media by teens and tweens is common. Children of all ages like playing video games, which they can access at home along with other gaming instruments.

The effects of screen time on children's development in the areas of cognition, language, physical development, and socioemotion

1. The cognitive domain takes into account variables like memory and attention span.
2. The language domain looks at language development, speaking, and vocabulary.
3. The physical domain emphasizes diet, sleep, exercise, and motor development
4. The social emotional domain considers self-identity and emotional behaviors/regulation [12].

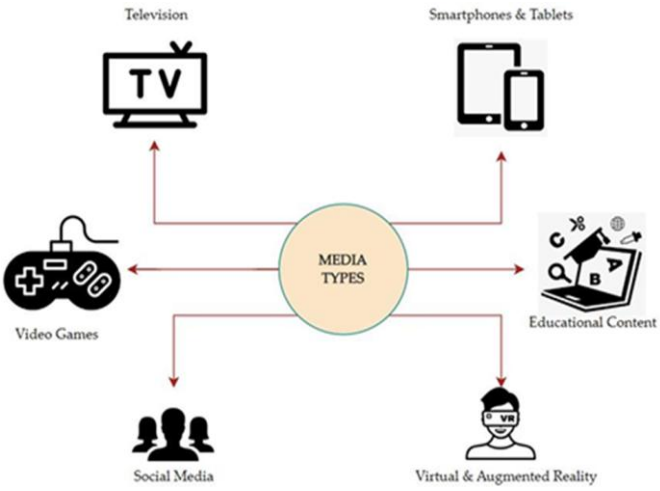


Fig 3: Different types of digital media

What is sleep

Both biologically and psychologically, sleep is essential. Sufficient sleep has a significant impact on mood, performance, and cognitive capacities, particularly during childhood and adolescence1. Schoolchildren frequently have sleep issues. An estimated 25% of kids are predicted to experience sleep issues at some point during their youth. Approximately 40% of teenagers and 30% of school-age youngsters struggle with sleep. Lack of sleep affects children's and teens' emotional and cognitive states in a number of ways. Inadequate sleep during childhood has been linked to concentration problems, poor decision-making, and memory loss. These factors may exacerbate scholastic difficulties and raise the risk of obesity, insulin resistance, and hypertension. Depression, suicidal thoughts, and emotional dysregulation are among the psychological impacts of sleep disturbance in teenagers.

Patterns of sleep vary throughout life. Sleep alterations can occur during adolescence, which spans from the ages of 10 to 19, for a variety of internal and external reasons. In addition to shifts in the biological clock, social responsibilities, and scholastic expectations, teenagers' sleep habits are also affected by the availability of television, video games, computers, and phones. television's detrimental effects on kids' and teens' behavioral and physical development. Inconsistent sleep patterns, reduced sleep duration, and sleep disorders are all signs of sleep disruption. Computer and smartphone use is linked to sleep disturbances and problems falling asleep [13].

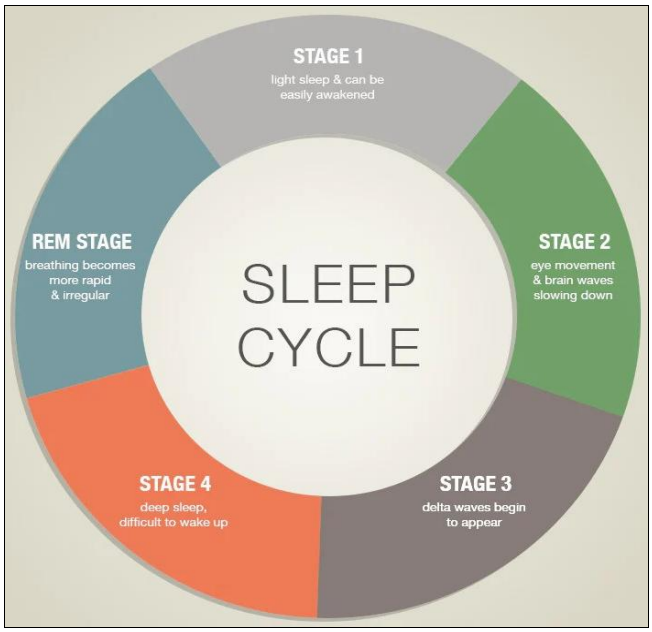


Fig 4: Sleep cycle

"What time do you normally go to bed during weekdays?" is a good way to gauge how much time is spent in bed. and "What time of day do you typically wake up on weekdays?" Two of the identical questions were evaluated on weekends.

By deducting "go to bed" time from "get up" time, the amount of time spent in bed was determined. To get the average weekly sleep time, the following formula was used:

The average amount of time spent in bed is equal to [(weekday time spent in bed 5) (weekend day time spent in bed 2)]/7 [4].

Estimates of daytime and nighttime sleep, as determined by yesterday's or tomorrow's time-use diaries, were added up to determine the total amount of sleep [10]. The quantity of time spent sleeping was expressed as "hours, minutes, of usual amount of sleep per day." In addition to weekdays and weekends, parents were advised to take into account their

child's nocturnal and daytime sleep patterns, including naps [11]. Obesity may also be caused by sleep disorders. One frequent consequence of fat that exacerbates other issues linked to obesity is sleep disorders. Sleep disorders have an impact on the human body's hormones and metabolism. Unusual hormones and metabolism may lead to a rise in unhealthy food consumption and obesity [14].

Epidemiology of sleep duration

The overall amount of time spent asleep, or duration, is one of the easiest aspects of sleep to quantify. A growing amount of evidence indicates that persistently getting too little sleep is linked to bad health.

Over time, the prevalence of obesity has increased as sleep has declined. Short sleep is thought to have an impact on obesity, which is typically characterized as having a body mass index (BMI) of 30 kg/m2.

Children and adults alike are increasingly suffering from short sleep durations and other forms of bad sleep habits in today's society [15].

Electronic devices may impact sleep in a variety of ways. Media consumption takes up a lot of time and might disrupt a regular sleep schedule. Unstructured activities, like sleeping, might take the place of other unstructured activities. Sleep would be disrupted by media because media consumption often peaks before bedtime [11].

Need of study

Nowadays, children's and adolescence are spent more time in front of screens they suffering from various health issues related to sleep and obesity. This study explore relation between screen times, sleep duration and its impact on body mass index. It helps to acknowledge the positive and negative feedback in school going children's for the better future.

Materials

1) Weighing scale
2) Stadiometer
3) Stationary

Methodology

Study design: A cross-sectional study
Study setting: School campus
Study population: School going children
Sample population: 7th and 8th standard students
Sample size: 62
Sampling technique: Convenient sampling

Criteria for selection

Inclusion criteria

1) Willingness to participates
2) Informed signed consent by parents
3) 7th and 8th standard students
4) Have been in digital learning

Exclusion criteria

1) Elite athlete's
2) Hereditary obesity
3) Eating disorders

Tools

1) Weighing scale
2) Stadiometer
3) BMI standard formula
4) Screen time app
5) WWFIT 2.0 APP (for sleep duration)

Weighing scale **Stadiometer**

Procedure

Informed written consent form taken from the subjects parents. Individuals from 7th and 8th standard were recruited based on inclusion/exclusion. Method for evaluating screen time, sleep duration and BMI was explained to each participant separately.

Screening was done of 65 subjects but 3 were excluded as they were elite athlete.

A total of 62 students were included to assess the correlation between screen time, sleep duration and BMI.

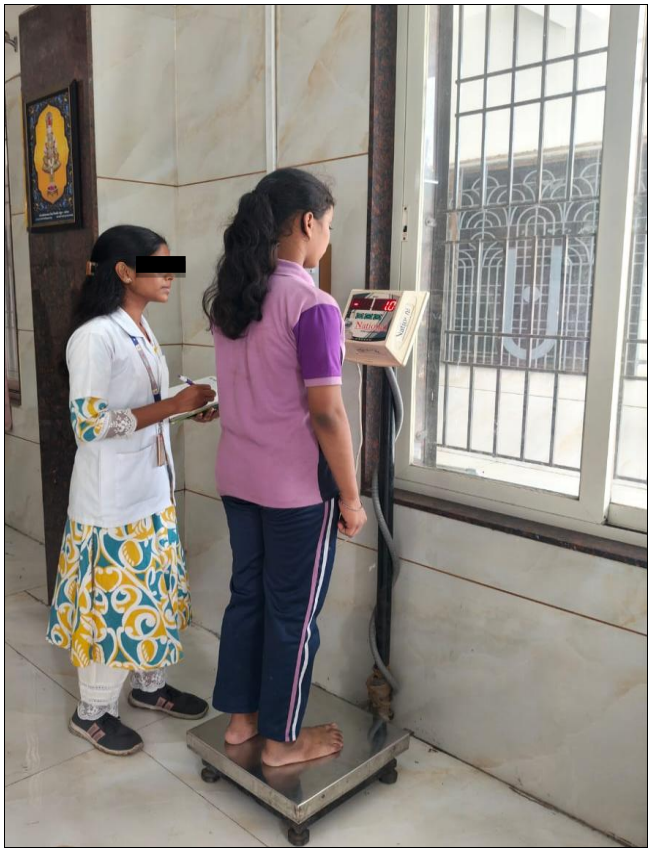


Fig 5: Measurement of weight using a digital weighing scale

Fig 6: Measurement of height using a stadiometer

Fig 7: Data collection from student participants

Method

First, the children's were grouped, and their height (by stadiometer) and weight (weighing scale) were measured. Subsequently, BMI was calculated using the standard formula. (weight in kg/height in m^2) after the anthropometric assessment, ask the children's information regarding their daily screen time (mobile and T.V viewing) using the screen time app and was collected.

Then followed by questioning about their sleep duration in hours for a night, using the WWFIT 2.0 APP was helped collect the data.

Result

Statistical analysis was performed in IBM SPSS (version 20).
The normality of the dataset was assessed using Shapiro-Wilks test as the sample size was 62.
The data analyzed include age, BMI, screen time, sleep duration.
The results are summarized below:

Table 1: Shapiro-Wilks test

Shapiro-Wilks test		
Variables	**Mean**	**Significance**
Age	13.42	0.000
BMI	16.92	0.665
Screen time	3.18	0.000
Sleep duration	8.70	0.003

Interpretation of Shapiro-Wilks test

The BMI, variable follow normal distribution (p<0.05). The age, Screen time, sleep duration variables do not follow normal distribution (p>0.05)

Table 2: Normally distributed and non-normally distributed variables along with the tests applied to them

Variables	Distribution
Age	Not normally distributed
BMI	Normally distributed
Screen time	Not normally distributed
Sleep duration	Not normally distributed

Since, BMI is normally distributed and screen time & sleep duration is not normally disturbed. Hence, we are going to use non-parametric test for correlation. (Spearman's correlation).

Table 3: Correlation between BMI and Screen time

Spearman's rho test				
Variables	**Mean**	**Standard deviation**	**p-value**	**r-value**
BMI	16.92	2.46	.105	-208
Screen time	3.18	3.07		

BMI and screen time shows p value >0.05 (0.105) and r value -208. This indicates mild negative correlation that is statistically not significant.

Table 4: Correlation between BMI and sleep duration

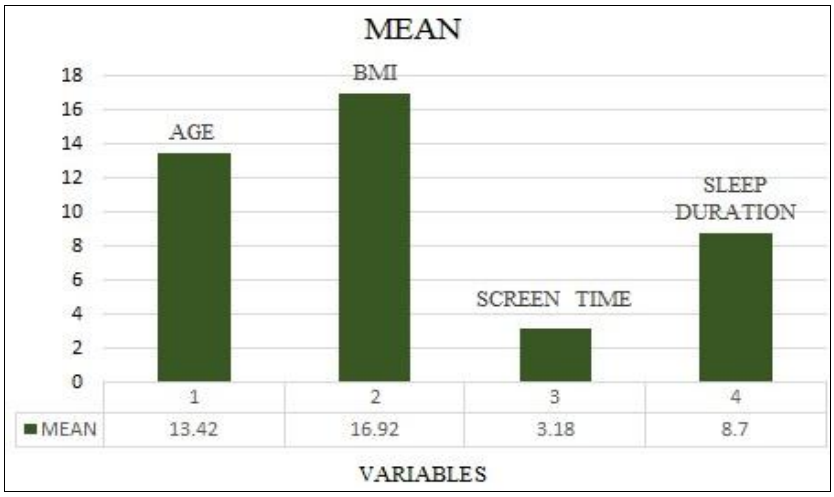
Spearman's rho test				
Variables	**Mean**	**Standard deviation**	**p-value**	**r-value**
BMI	16.92	2.46	.783	.036
Sleep duration	8.70	2.45		

BMI and sleep duration shows p value <0.05(0.783) and r value .036 This indicates mild positive correlation that is statistically not significant.

Table 5: Correlation between screen time and sleep duration

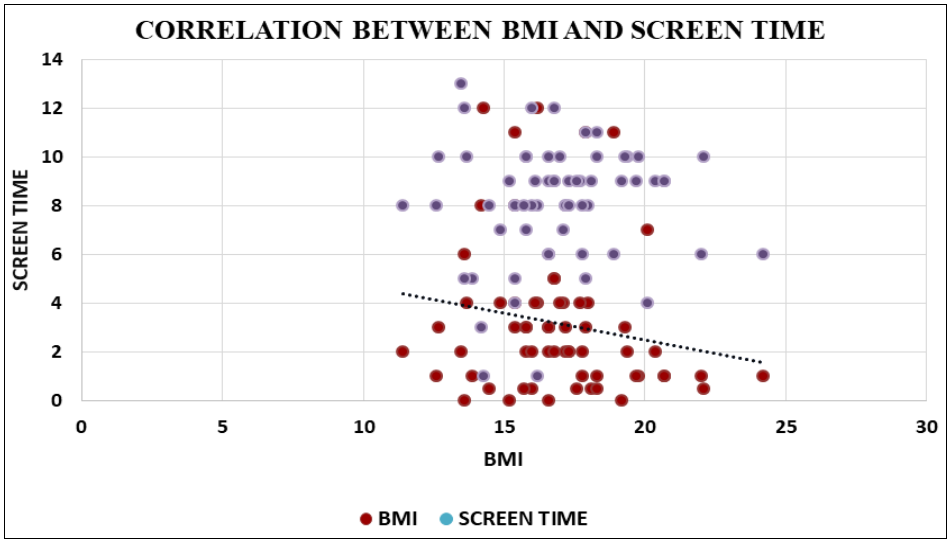
Spearman's rho test				
Variables	**Mean**	**Standard deviation**	**p-value**	**r-value**
Screen time	3.18	3.07	.085	-221
Sleep duration	8.70	2.45		

Screen time and sleep duration shows p value >0.05 (0.085) and r value -221. This indicates mild negative correlation that is statistically not significant.



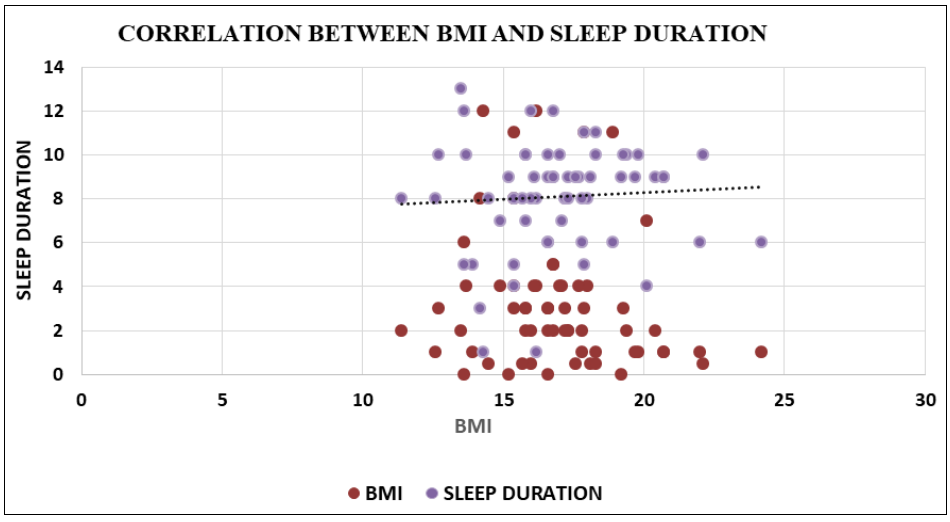
Graph 1: Age, BMI, screen time and sleep duration mean graph

(X-Axis = Variables, Y-Axis = Mean value of the variables).



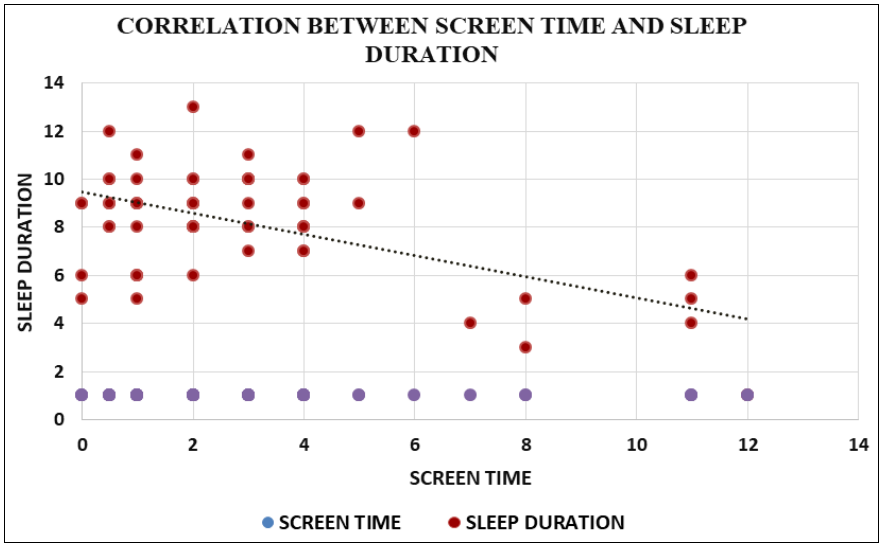
Graph 2: Correlations between BMI and screen time

(X-Axis = BMI, Y-Axis =Screen Time).



Graph 3: Correlations between BMI and sleep duration

(X-Axis = BMI, Y-Axis =Sleep Duration).



Graph 4: Correlations between screen time and sleep duration

(X-Axis = Screen Time, Y-Axis =Sleep Duration).

The results of this study states that:

1. The correlation between BMI and Screen time shows mild negative correlation that is not statistically significant thus, we are fail to reject Null Hypothesis.
2. The correlation between BMI and Sleep duration shows mild positive correlation that is statistically significant thus; we are fail to reject Null Hypothesis.
3. The correlation between Screen time and Sleep duration shows mild negative correlation that is not statistically significant thus, we are fail to reject Null Hypothesis.

Discussion

The purpose of this study was to assess how screen time and sleep length affected school-age children's BMI.

In recent years, the lifestyle habits of school-going children have changed significantly, with increased screen exposure and altered sleep patterns. These changes are strongly associated with BMI, a widely used indicator of body fat and overall health status. Understanding how BMI impacts screen time and sleep duration, or vice versa, is crucial for promoting healthy behaviors in children. Relationship between BMI and Screen Time.

In this study total 62 participants are included, individuals from 7th and 8th standard school-going children. For assessing the body mass index using the standard formula to calculate the BMI. Then, using the screen time app for assessing the student's viewing the TV and using the mobile in hrs/day. And the WWFIT 2.0 APP helped to measure the sleep duration. IBM SPSS (version 20) was then used to do statistical analysis. The normality of the data set was assessed using the Shapiro-Wilk test as the sample size was 62. Positive and negative correlations occurred in this study. Positive correlation between BMI- sleep duration obtained a p-value of 0.783, r-value is .036. Mild negative correlation between BMI –screen time obtained the p-value 0.105 and r-value is -208. And correlation between screen time –sleep duration obtained the p-value 0.085 and r value -221.

Tomislav *et al*. (2018) findings of the study separate and simultaneous associations between sleep duration and sleep quality with overweight/obesity status in a large sample, results showed that both short and long time spent in bed and poor sleep Overweight or obesity status was linked to quality. There was no correlation found between long sleep duration and BMI, while others found a favorable correlation between BMI and short sleep duration. Overall, the results consistently demonstrate a correlation between BMI and short sleep duration. The findings then demonstrated a correlation between a higher chance of being overweight or obese and poor sleep quality. In children, adolescents, and young adults, inadequate sleep length was linked to overweight/obesity status regardless of sleep duration, according to a recent meta-analysis. The participants in this study were distributed nearly evenly between males (54.2%) and females (45.8%). This outcome was comparable to that of a study by Bhattacharya K *et al*., in which the gender ratio was likewise balanced. This suggests that parameters associated to BMI, such screen time and sleep duration, are important for both sexes. According to Jingbo Qi *et al*. (2023), school-aged children today are continuously surrounded by technology, from social media and smartphones to TV and tablet-based online courses. This review's main goal was to provide an overview of the current state of school-aged children's screen time usage and duration. Our research indicates that excessive screen usage is a major public health concern in high- and middle-income nations and is highly prevalent among schoolchildren aged 6 to 14. In addition to affecting school-aged children's growth and cognitive development, excessive screen usage has a number of negative health implications, such as emotional, sleep, and behavioral issues. Certain high-income nations, including the US and Germany, have created policies to limit excessive use of digital media by all age groups, but other low- and middle-income nations have not. National Health in 2021. According to Mortazavi S. *et al*. (2019) [13], the primary goal of this study was to evaluate the connection between screen usage and sleep metrics including sleep duration in adolescents and school-age children. Results indicated that shorter sleep duration was linked to more than two hours of computer use or TV viewing each day. Adolescents frequently use electronic devices, and prior research has shown a negative correlation between TV use and sleep length as well as a delay in bedtime and wake-up time21. Overuse of computers might cause sleep issues and a reduction in bedtime. To sum up, using electronic media has been linked to delayed bedtime and decreased sleep.

According to Elizabeth B. *et al*. (2021) [14], the majority of the obese children 14 out of 19 were male (73.7%), but the proportion of male and female children who were not obese or malnourished was equal. The results of a follow-up chi-square test showed no association between sex and obesity in school-age children (p-value = 0.252 > 0.05). After school, students tended to spend less time engaging in physical activities like playing video games, watching TV, or engaging in light-intensity indoor activities. None of the respondents engaged in vigorous-intensity exercise as their weight prevented them from doing so, and the majority (59.5%) engaged in light-intensity exercise, or fewer than 5,000 steps per day. There was a reduction in physical activity among many children worldwide. Because it increases bone mineral density and indirectly prevents overweight, physical activity benefits children and adolescents and has a significant impact on their health as adults. Additionally, the development of technology influences children's play activities.

Given the correlation between children's sitting time and body fat percentage, the current study's tendency toward a sedentary lifestyle is consistent with other authors' findings (9, 10), indicating that inactivity is a major contributing factor to the development of childhood obesity. Yet, the fact that the number of hours of sleep recorded in this study might support a reduction in body fat indicates that sleep might have a favorable effect on preserving children's body composition and should be promoted, particularly for those who are overweight or obese. There are no additional reports on this topic that we could find in the literature. It should be noted, however, that although significant, the connections in both cases were weak, indicating the need for additional research, particularly into how sleep affects children's energy balance (Giugliano R. *et al*., 2004) [6]. The use of technology by young children can have both beneficial and detrimental effects. It can help toddlers acquire new skills, enhance their hand-eye coordination, and foster their creativity and curiosity, among other educational advantages. On the other hand, toddlers who use technology excessively may experience behavioral issues, poor social skills, and delayed language development. Additionally, it can result in addiction, poor sleep, and childhood obesity. In 2023, Panjeti-Madan VN *et al*.

Conclusion

This study concluded that is mild negative correlation has been found between BMI-Screen time and Screen time-Sleep duration, among school-going children. This suggests that BMI reduces with increasing screen time and vice versa. & Screen time increases with decreasing sleep duration and vice versa. But it is not statistically significant. The correlation that has been found may be due to chance. These findings suggest that school-going children, with increasing screen time, reduce sleep duration. There is also a mild positive correlation between BMI and sleep duration, which suggests that increasing BMI is also associated with sleep duration.

The present study aimed to assess the correlation between screen time, sleep duration, and body mass index in 7th and 8th -standard school-going children. A total of 62 students are participants in this study.

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