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Effect Of Screen Time On Cardiovascular Health In School Going Children

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Abstract

Background:*The rapid proliferation of digital technology has led to increased screen exposure among children, often at the cost of physical activity, sleep, and social interaction. Excessive screen time is now being recognized as a potential risk factor for early-onset cardiovascular and metabolic disorders. While international guidelines have established permissible screen time durations, there is limited data evaluating the cardiometabolic impact of screen usage among children in semi-urban Indian settings.*

Aim:*To estimate the association of screen time with cardiovascular health parameters among school-going children aged 6–18 years.*

Objectives: *To determine the average screen time in the study population; to assess its association with cardiovascular indicators such as BMI, blood pressure, waist circumference, blood glucose, and lipid profile; and to analyze the relationship between physical activity and screen time.*

Materials and Methods:*This cross-sectional observational study was conducted over six months among 171 school-going children in the 6–18-year age group from selected schools in Chengalpattu district. Data collection included a structured proforma capturing sociodemographic variables, physical activity, and screen time. Anthropometric measurements (height, weight, waist circumference), blood pressure, random blood sugar, and lipid profile were assessed using standard protocols. Data were analyzed using SPSS v17.0, applying appropriate statistical tests at a 5% level of significance.*

Results:*A significant proportion of children reported screen time exceeding two hours daily. Increased screen exposure was significantly associated with higher BMI and waist circumference, indicating a trend toward overweight and obesity. Children with longer screen time had elevated systolic and diastolic blood pressures. Biochemical markers revealed higher mean values of random blood sugar, total cholesterol, LDL, and triglycerides, with lower HDL levels in the high screen-time group. Inverse relationships between activity levels and day-time screen use were reported, indicating a distinct displacement effect.*

Conclusion:*The research shows that an intense relationship exists between extended screen use and poor cardiovascular health indicators in children. High screen use is associated with obesity, raised blood pressure, poor glycemic control, and dyslipidemia. These observations highlight the need to limit screen use and promote physical activity in children to prevent long-term cardiovascular risk.*

Keywords: *Screen Time, Cardiovascular Health, School Children, Obesity, Blood Pressure, Lipid Profile, Physical Activity*

INTRODUCTION

The rapid increase in children's and adolescents' use of electronic media has revolutionized the context of childhood entertainment, education, and communication. Ranging from smart phones and tablets to television and gaming devices, screen-based technologies have become part of daily life. Though technology has brought certain benefits, it has also led to a significant lifestyle shift in the pediatric population **[1].** Growing dependence on screen-based recreational activities has been accompanied by decreased physical activity, unhealthy dietary habits, and increased sedentary time. These trends in behavior are being identified as major drivers of early-onset

non-communicable conditions, especially cardiovascular-related ones **[2].**Excessive screen time in children has been strongly associated with a range of negative health outcomes. It promotes the adoption of unhealthy habits such as consumption of calorie-dense, nutrient-poor foods—collectively categorized as 'JUNCS' (junk foods, ultra-processed items, nutritionally inappropriate choices, carbonated drinks, and sugar-laden snacks) **[3]**. Combined with diminished physical activity, these habits contribute to a positive energy balance and increase the risk of developing exogenous obesity. Unlike genetic or constitutional obesity, exogenous obesity is directly linked to modifiable lifestyle factors, and therefore, represents a critical target for early intervention. Notably, childhood obesity has shown a strong tendency to persist into adolescence and adulthood, laying the foundation for long-term cardiovascular and metabolic diseases **[4]**.There is growing epidemiological evidence that excessive screen exposure is independently associated with early markers of cardiometabolic dysfunction. Several studies have demonstrated that children with prolonged screen time exhibit increased systolic blood pressure, elevated fasting glucose levels, adverse lipid profiles (including high non-HDL cholesterol), and higher waist circumference measurements all of which are considered harbingers of cardiovascular disease (CVD) **[5]**. These initial changes, if not treated, can escalate into apparent cardiovascular conditions in adulthood, such as atherosclerosis, ischemic heart disease, and type 2 diabetes mellitus. Therefore, the comprehension and alteration of screen-based behaviors in childhood can have significant long-term effects on cardiovascular health **[6].**To reduce the harmful effects of overuse of screen time, global and national health organizations have prepared evidence-based guidelines that stress the use of screen time in a manner appropriate for age and physical activity **[7].** The World Health Organization (WHO) suggests that infants 0–1 years old must not be given any screen media, except for video calls. For the 2–4-year-old children, screen use must be kept to not more than one hour a day, with special attention to high-quality content and active parental involvement. For the age group of 5–17 years, leisure screen time must be kept to a limit of two hours a day, coupled with attempts to promote physical activity and social interaction **[8].**The American Academy of Pediatrics (AAP) also makes these recommendations, modified somewhat by age stage. For children 18 months and younger, screen time is to be completely avoided except for video chatting with a caregiver. From 18 to 24 months, high-quality digital media is introduced but only while co-viewed with an adult to help interpret **[9].** Children between 2 and 5 years must be limited to one hour of high-quality programming per day with parental participation. In individuals aged 6 years and above, stable and tailored boundaries must be established to ensure that screen time does not disrupt core activities like sleep, physical activity, school, and social relationships **[10].**In the Indian context, the Indian Academy of Pediatrics (IAP) has also made specific guidelines to direct screen usage in children. It recommends that children below 2 years should not be shown any screen at all, except for the odd video call. In children who are 2 to 5 years old, the amount of screen time should be restricted to one hour a day, and less if possible **[11].** Older children and adolescents should maintain a healthy balance, ensuring that screen use does not encroach upon critical developmental activities such as outdoor play (minimum of one hour per day), adequate sleep (8–9 hours nightly), academic commitments, family engagement, and personal hobbies. Any compromise of these areas due to screen exposure is termed “excessive screen time” and necessitates corrective action **[12]**.Despite these detailed guidelines, real-world adherence remains poor, particularly in semi-urban and rural regions of India where awareness is limited, and digital access has rapidly expanded due to affordable smartphones and widespread internet availability. Notably, there is a dearth of region-specific studies evaluating the actual impact of screen time on cardiovascular risk markers among Indian children. While most existing literature originates from urban settings or international cohorts, the unique sociodemographic and lifestyle factors prevalent in semi-urban regions such as Chengalpattu district, Tamil Nadu, remain underexplored. Children in these areas may face a different set of behavioral, nutritional, and environmental challenges that influence how screen time impacts their health.

Novelty of the Study

This study addresses a critical knowledge gap by evaluating the association between screen time and cardiovascular health in school-going children from the suburban region of Chengalpattu. To date, limited data is available on the cardiometabolic effects of screen usage among Indian children residing in such settings. The results of this research have the potential to inform local and national public health policies, and contribute toward the development of more tailored, culturally appropriate guidelines for screen time and lifestyle management in children. Furthermore, early identification of at-risk individuals through school-based assessments may help in initiating timely interventions aimed at preventing long-term cardiovascular morbidity.

MATERIALS AND METHODS

Study Design and Setting

This study was designed as a cross-sectional observational study and was conducted over a period of six months at the Department of Pediatrics, Shri Sathya Sai Medical College and Research Institute, located in Ammapettai, Chengalpattu district, Tamil Nadu. The study aimed to explore the relationship between screen time and cardiovascular health among school-going children in a semi-urban population.

Study Population

The study population included children aged 6 to 18 years from selected schools in and around Ammapettai. Schools were chosen using stratified random sampling to ensure adequate representation across different age groups and socio-economic backgrounds. Participants were recruited after obtaining appropriate institutional permissions, parental informed consent, and child assent.

Sample Size Estimation

The sample size was calculated using the standard formula for cross-sectional studies:

$$N = 4pq / l^2,$$

where:

- p = estimated prevalence of excessive screen time = 52.5% (based on previous studies),
- q = 100 – p = 47.5%,
- l = allowable error = 8%.

Substituting the values:

$$N = (4 \times 52.5 \times 47.5) / (8 \times 8) = 9975 / 64 \approx \mathbf{156}$$

Considering a 10% non-response rate, the final sample size was rounded up to **171 participants**.

Sampling Method

A multi-stage stratified random sampling technique was used. Schools were first categorized by type (private vs. government), and then children were randomly selected from each age group to ensure proportionate representation. Equal distribution was maintained across both genders to minimize selection bias.

Inclusion Criteria

- School-going children aged 6 to 18 years.
- Children whose parents/legal guardians provided written informed consent.
- Children who provided assent (for those above 7 years of age).

Exclusion Criteria

- Children with known systemic illnesses such as chronic kidney disease (CKD) or congenital/acquired cardiovascular disorders (e.g., coarctation of the aorta).
- Children on medications that affect blood pressure regulation (e.g., steroids, stimulants).
- Children with neurological deficits or developmental delays impacting motor function or screen behavior patterns.

Data Collection Procedure

Data were collected using a structured and pretested patient datasheet, which was administered in the local language for parental and participant understanding. This datasheet included demographic information, screen time habits, physical activity levels, dietary patterns, family history of cardiovascular diseases, and socioeconomic status (assessed using the modified Kuppuswamy scale).

Screen Time Assessment

Screen time was defined as the total duration spent in front of any digital screen (television, smartphones, tablets, laptops, gaming devices) for recreational purposes, excluding time spent for schoolwork. The duration was recorded in hours per day, averaged over a typical week.

Physical Activity Assessment

The International Physical Activity Questionnaire (IPAQ) short form was adapted to assess the frequency and intensity of physical activity, including playtime, sports participation, and daily exercise. Activities were classified as light, moderate, or vigorous.

Anthropometric Measurements

Standardized equipment and techniques were used for anthropometric assessments:

- **Height** was measured using a wall-mounted stadiometer to the nearest 0.1 cm.
- **Weight** was measured using a calibrated digital weighing scale to the nearest 0.1 kg.

- **Body Mass Index (BMI)** was calculated as weight (kg) divided by height (m^2) and interpreted using age- and sex-specific percentile charts as per Indian Academy of Pediatrics (IAP) growth references.
- **Waist Circumference** was measured at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest using a non-elastic measuring tape.
- **Body Fat Percentage** was estimated using bioelectrical impedance analysis (if available) or from skinfold thickness charts.

Blood Pressure Measurement

Blood pressure (BP) was measured using an aneroid sphygmomanometer with an appropriately sized pediatric cuff. Two readings were taken at a five-minute interval after the child had rested quietly for at least ten minutes. The average of the two readings was recorded. Elevated BP was defined using percentiles based on age, gender, and height as per standardized pediatric norms.

Biochemical Investigations

- **Random Blood Sugar (RBS)**: Obtained via capillary blood sample using a calibrated glucometer.
- **Lipid Profile**: Fasting blood samples (where feasible) were collected using vacutainer tubes and analyzed in the institutional laboratory for:
    - Total cholesterol
    - LDL cholesterol
    - HDL cholesterol
    - Triglycerides
    - Non-HDL cholesterol (calculated as Total cholesterol – HDL)

Study Tools and Instruments

- Stadiometer for measuring height
- Calibrated digital weighing scale
- Non-stretchable measuring tape for waist circumference
- Aneroid sphygmomanometer with pediatric cuffs
- Glucometer for RBS
- Vacutainer tubes for blood collection and biochemical analysis

Study Variables Independent Variable:

- Daily screen time (in hours)

Dependent Variables:

- Body Mass Index (BMI)
- Waist circumference
- Body fat percentage
- Blood pressure (systolic and diastolic)
- RBS value
- Lipid profile parameters

Confounding/Interacting Variables:

- Age, gender, socioeconomic status, physical activity, diet, sleep duration, family history of CVD.

Data Management and Statistical Analysis

All collected data were entered into Microsoft Excel and exported to SPSS version 17 for statistical analysis. Descriptive statistics (mean, standard deviation, frequencies, and percentages) were used to summarize the baseline characteristics of the participants. Associations between screen time and cardiovascular parameters were assessed using appropriate inferential statistics:

- Chi-square test for categorical variables
- Independent t-test or ANOVA for continuous variables
- Pearson or Spearman correlation for linear associations
- Logistic regression for adjusted risk analysis (if applicable)

A p-value < 0.05 was considered statistically significant, and all statistical tests were conducted with a 95% confidence interval.

Ethical Considerations

The study was approved by the Institutional Ethics Committee (IEC) of Shri Sathya Sai Medical College and Research Institute. Written informed consent was obtained from the parents or guardians, and assent was taken

from children aged 7 years and above. Confidentiality was maintained at all stages of data collection, storage, and analysis.

RESULT

A total of 171 school-going children aged 6 to 18 years were enrolled in this study. Participants were assessed for screen time exposure, anthropometric measurements, physical activity levels, blood pressure, blood sugar, and lipid profile parameters. The data were analyzed to determine the association between screen time and cardiovascular health indicators.

Table 1: Age and gender distribution of the study population

Table 1 shows that the majority of children belonged to the 13–15 years age group (34.5%), followed by the 10–12 years age group (30.4%). The study population comprised 88 males (51.5%) and 83 females (48.5%), indicating an almost equal gender distribution.

Age Group (Years)	Male (n=88)	Female (n=83)	Total (n=171)	Percentage (%)
6–9	15	16	31	18.1
10–12	26	26	52	30.4
13–15	31	28	59	34.5
16–18	16	13	29	17.0

Table 2: Average daily screen time distribution among participants

Table 2 illustrates that 37.4% of children reported screen time of 2–3 hours daily, followed by 28.7% with 1–2 hours. Only 11.1% of participants reported screen time of less than 1 hour per day.

Screen Time (hrs/day)	Frequency (n)	Percentage (%)
<1 hour	19	11.1
1–2 hours	49	28.7
2–3 hours	64	37.4
>3 hours	39	22.8

Table 3: Mean BMI across screen time categories

Table 3 reveals that the mean BMI increased with longer screen time. Children with >3 hours of screen time had a mean BMI of 22.6 ± 3.4 kg/m², significantly higher than those with <1 hour screen time (18.4 ± 2.2 kg/m²) ($p < 0.001$).

Screen Time (hrs/day)	**Mean BMI (kg/m²) ± SD**
<1 hour	18.4 ± 2.2
1–2 hours	20.1 ± 2.8
2–3 hours	21.3 ± 3.1
>3 hours	22.6 ± 3.4

Table 4: Prevalence of overweight and obesity in relation to screen time

As shown in Table 4, obesity prevalence was highest (41%) in children with screen time >3 hours, while children with <1 hour screen time showed the lowest rates of overweight and obesity.

Screen Time (hrs/day)	**Normal** (%)	**Overweight** (%)	**Obese** (%)
<1 hour	79	16	5
1–2 hours	63	24	13
2–3 hours	48	33	19
>3 hours	33	26	41

Table 5: Mean waist circumference across screen time categories

Table 5 shows that children with >3 hours of screen time had significantly higher waist circumference (78.2 ± 6.1 cm) compared to those with <1 hour (66.3 ± 4.5 cm), indicating increased central adiposity with prolonged screen exposure.

Screen Time (hrs/day)	**Mean Waist Circumference (cm) ± SD**

<1 hour	66.3 ± 4.5
1–2 hours	71.8 ± 5.2
2–3 hours	74.5 ± 5.7
>3 hours	78.2 ± 6.1

Table 6: Association between screen time and physical activity levels

Table 6 indicates that a majority (72%) of children with >3 hours of screen time engaged in low physical activity, while higher physical activity was seen among children with <1 hour screen time.

Screen Time (hrs/day)	**Low Activity** (%)	**Moderate Activity** (%)	**High Activity** (%)
<1 hour	11	47	42
1–2 hours	28	52	20
2–3 hours	51	39	10
>3 hours	72	21	7

Table 7: Mean systolic and diastolic blood pressure by screen time

As presented in Table 7, systolic and diastolic BP values were progressively higher in groups with greater screen exposure, suggesting a dose-response effect.

Screen Time (hrs/day)	**Mean SBP (mmHg) ± SD**	**Mean DBP (mmHg) ± SD**
<1 hour	104.2 ± 6.8	67.3 ± 5.1
1–2 hours	108.5 ± 7.1	70.8 ± 6.2
2–3 hours	111.3 ± 6.9	72.6 ± 6.0

>3 hours	115.7 ± 7.5	76.4 ± 6.5

Table 8: Mean RBS levels in relation to screen time

Table 8 shows a significant upward trend in RBS values with increasing screen time. The highest mean RBS (123.8 mg/dL) was noted among children with >3 hours of screen use (p = 0.02).

Screen Time (hrs/day)	Mean RBS (mg/dL) ± SD
<1 hour	97.4 ± 11.6
1–2 hours	102.6 ± 13.2
2–3 hours	110.7 ± 14.5
>3 hours	123.8 ± 17.4

Table 9: Lipid profile values by screen time category

Table 9 reveals elevated total cholesterol, LDL, and triglycerides in the >3-hour screen time group. HDL levels were lowest in this group, indicating a negative lipid profile pattern associated with prolonged screen use.

Screen Time (hrs/day)	Total Cholesterol (mg/dL)	LDL (mg/dL)	HDL (mg/dL)	Triglycerides (mg/dL)
<1 hour	154.2 ± 21.6	84.1 ± 12.3	47.8 ± 5.4	106.3 ± 17.1
1–2 hours	168.3 ± 25.4	92.6 ± 13.9	45.6 ± 4.9	121.7 ± 18.2
2–3 hours	178.5 ± 27.1	98.4 ± 15.6	42.1 ± 5.2	135.4 ± 20.7
>3 hours	192.7 ± 30.5	105.6 ± 17.2	38.9 ± 5.0	149.6 ± 24.3

Table 10: Correlation between screen time and cardiovascular parameters

Table 10 demonstrates a statistically significant positive correlation between screen time and BMI, waist circumference, blood pressure, and RBS, while a negative correlation was observed with HDL levels.

Parameter	Pearson's Correlation Coefficient (r)	p-value

BMI	+0.421	<0.001
Waist Circumference	+0.447	<0.001
Systolic BP	+0.398	<0.001
Diastolic BP	+0.371	<0.001
RBS	+0.356	0.02
HDL Cholesterol	-0.289	0.03

Table Summary
The study included 171 children, with the highest representation in the 13–15 years age group and an almost equal gender split (Table 1). Most participants reported screen time of 2–3 hours daily (Table 2). A significant positive association was found between screen time and BMI (Table 3), overweight/obesity (Table 4), and waist circumference (Table 5). Children with prolonged screen exposure had reduced physical activity levels (Table 6) and higher systolic and diastolic blood pressure readings (Table 7). Biochemical analysis showed rising RBS levels and a worsening lipid profile with increasing screen time (Tables 8 and 9). Correlation analysis confirmed these findings, indicating a direct association between prolonged screen time and adverse cardiovascular risk factors such as obesity, central adiposity, elevated blood pressure, hyperglycemia, and dyslipidemia (Table 10).

DISCUSSION

This study examined the impact of screen time on various cardiovascular health indicators in school-going children aged 6 to 18 years. The results of this cross-sectional observational study highlight a growing concern an increasing number of children are exceeding the internationally recommended screen time limits **[13]**. A significant portion of the participants reported daily screen exposure of more than two hours, reflecting a sedentary lifestyle that is becoming increasingly prevalent among children, particularly in semi-urban Indian settings like Chengalpattu.One of the key findings of this study was the evident association between prolonged screen exposure and elevated body mass index (BMI). Children with more screen time exhibited a higher prevalence of overweight and obesity **[14]**. This may be attributed to multiple interconnected factors such as physical inactivity, increased consumption of calorie-dense snacks during screen use, and reduced sleep duration. These factors contribute cumulatively to positive energy balance and fat accumulation, particularly in the abdominal region. Central obesity, as indicated by increased waist circumference, further affirms the link between sedentary screen behavior and metabolic risk **[15,16]**.Physical activity showed an inverse relationship with screen time, indicating that increased time spent on screens is displacing time that could otherwise be used for moderate or vigorous physical activity. This displacement effect is well-documented in literature and aligns with recommendations from the World Health Organization and the Indian Academy of Pediatrics, both of which emphasize a balanced lifestyle that limits recreational screen use and promotes outdoor activity for optimal physical and psychosocial development **[17,18]**.Hemodynamic parameters such as systolic and diastolic blood pressure also showed a rising trend with longer screen time. The elevated blood pressure values observed in children with higher screen exposure could be the result of increased sympathetic nervous system activity and vascular stiffness secondary to chronic sedentary behavior. These subtle yet significant changes in vascular physiology during childhood may progress silently and contribute to early onset hypertension and cardiovascular morbidity in adulthood **[19,20]**.Glycemic status, assessed through random blood sugar levels, revealed a tendency towards hyperglycemia in children who reported longer durations of screen time. This association might be

influenced by insulin resistance, a condition increasingly being recognized in obese children. Screen time may indirectly exacerbate glycemic dysregulation by promoting unhealthy snacking behaviors and physical inactivity, both of which reduce insulin sensitivity **[21,22]**.Biochemical analysis of lipid profiles in the study population demonstrated a pattern of dyslipidemia characterized by elevated total cholesterol, LDL cholesterol, and triglycerides, along with a decrease in HDL cholesterol in children with higher screen time exposure. This lipid pattern is typical of sedentary individuals and is an established cardiovascular risk factor. The clustering of obesity, elevated blood pressure, impaired glucose metabolism, and dyslipidemia in children with higher screen exposure points toward the early manifestation of metabolic syndrome—a condition previously considered uncommon in pediatric populations **[23]**.The cumulative evidence from this study strongly indicates that screen time is not just a benign pastime but a modifiable behavioral risk factor that has wide-reaching implications on cardiovascular health. These findings are consistent with global trends and echo concerns raised by pediatric associations worldwide. However, the problem is further compounded in Indian semi-urban settings where awareness, structured interventions, and parental monitoring may be lacking **[24]**.The strength of this study lies in its comprehensive approach—assessing not just one, but multiple cardiovascular markers in a single pediatric population and analyzing them in relation to screen time duration. However, there are a few limitations. First, the cross-sectional nature of the study does not allow for causal inferences to be drawn. Second, screen time and physical activity were self-reported, introducing the possibility of recall and reporting bias. Dietary habits, an important confounding variable in cardiometabolic health, were not accounted for in the analysis. Furthermore, the study was limited to selected schools in a single semi-urban locality, which may affect the generalizability of the results to other geographic or socio-economic settings.Despite these limitations, the study offers valuable insight into an emerging public health issue. It reinforces the urgent need for intervention strategies that focus on educating parents, children, and school authorities about the risks associated with excessive screen use. Regular screening for cardiovascular risk factors in children with high screen exposure, coupled with lifestyle counseling, could prove beneficial in mitigating long-term health consequences.

CONCLUSION

The study clearly establishes a significant association between increased screen time and adverse cardiovascular health parameters in school-going children. Prolonged screen exposure is linked with higher BMI, central obesity, elevated blood pressure, increased blood glucose levels, and unfavorable lipid profiles. These findings underscore the need to monitor and regulate screen time in children, promote physical activity, and initiate early interventions to reduce the risk of future cardiovascular disease.

Author(s) contribution(s) All authors contributed equally to the study design, data collection, statistical analysis, and manuscript preparation. All authors reviewed and approved the final version of the manuscript.

Ethical approval The study received ethical clearance from the Institutional Ethics Committee of Shri Sathya Sai Medical College and Research Institute, Ammapettai.

Informed consent Written informed consent was obtained from the parents or guardians of all participating children. Verbal or written assent was also obtained from children as appropriate.

Declaration of Helsinki This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki (2013 revision).

Availability of research data Data supporting the findings of this study are available from the corresponding author upon reasonable request.

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Conflict of Interest Statement The authors declare no conflict of interest related to this research.

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