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PREVALENCE OF OBESITY IN PREADOLESCENT CHILDREN IN URBAN SCHOOLS AND ASSOCIATION OF SCREEN TIME WITH BODY MASS INDEX POST PANDEMIC

Paediatrics

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ABSTRACT

Excessive screen use is linked to obesity, behavioral issues, and academic decline. The COVID-19 pandemic and resulting lockdowns led to school closures, and increasing screen time in children. This study estimates obesity prevalence among pre-adolescent children and examines its association with screen time. A cross-sectional study was conducted on 524 children aged 6–12 years, post ethical clearance. Socio-demographics, anthropometric data and screen time were assessed using the Digital Screen Exposure Questionnaire (DSEQ). Data were analyzed using descriptive and inferential statistics. Among the 524 children (271 males, 253 females; mean age 10.7 years), 70.5% had normal BMI, 10.5% were underweight, 12.2% overweight, and 6.9% obese. Most used screens <2 hours/day, with increased use on holidays. Over half accessed entertainment and adult content; 57.6% had screen use rules at home. Mean DSEQ scores: underweight – 263.42, normal – 276.25, overweight – 263.27, obese – 255.71. Overall mean: 270.07 (SD = 123.26). Despite normal BMI in most, unhealthy screen habits and reduced activity indicate emerging health risks. Higher BMI correlates with increased screen exposure and lower activity. Routine pediatric evaluations should address lifestyle habits to support early intervention.

KEYWORDS

Screen time, body mass index, post COVID-19, Obesity, Pre-adolescent

INTRODUCTION

During COVID-19 pandemic the height of the pandemic, a range of public health measures including lockdown, home confinement, school closures and restrictions on outdoor activities, were implemented to curb the transmission of the virus (1-3).

With the closure of educational institutions, children had to adapt to virtual learning environments. These digital platforms became the primary medium for education, communication, and recreation. Children across various age groups found themselves spending significantly more time on screens than was ever previously recommended or considered healthy.(4)

A recent report from the USA found that daily screen usage for recreational purposes among children nearly doubled from an average of 3.8 hours before the pandemic to 7.7 hours during it (4). This rise in screen engagement raises serious concerns, given the well-documented associations between excessive screen time and adverse health outcomes like higher risks of obesity, depression, anxiety, behavioral issues, and reduced academic performance.

With children adopting more sedentary habits and unhealthy sleep and screen time patterns during the pandemic, there is concern about a potential increase in the early onset of many non-communicable diseases. (5–8).

In view of above findings, this study was aimed at assessing the current prevalence of childhood obesity and evaluating the correlation between screen time and anthropometric outcomes among children in the post-COVID-19 era.

MATERIALS AND METHODS

This prospective cross-sectional observational study included school-going children aged 6 to 12 years was conducted in urban private schools in Bangalore. Children were selected through stratified random sampling and excluded if they had chronic illnesses such as renal failure, congenital heart disease, syndromes, or malformations. Ethical clearance obtained from the Institutional Ethical Review Board (IERB).

Anthropometric assessments included measurements of weight, height, and head circumference, using calibrated instruments. BMI was calculated using the standard formula (weight in kg/height in m²). Assessment of screen time was done using a structured questionnaire namely Digital Screen Exposure Questionnaire (DSEQ).

The minimum sample size required was 460 calculated using formula $4pq/d^2$ based on a study done by Moitra P and Madan J, that reported average screen time of 442.3 minutes/week among adolescents, with a 95% confidence interval and 5% precision, accounting for a 10% non-response rate.

Descriptive statistics included frequencies, proportions, means, and standard deviations. Chi-square, Fisher's exact, and t-tests were used for significance testing, with $p < 0.05$ considered statistically significant.

Table – 1 Descriptive Statistics Of Socio-demographic Categorical Variables

variable	category	Numbers (%)
Gender	Male	271 (51.7)
	Female	253 (48.3)
Age (in years)	6	8 (1.5)
	7	21 (4)
	8	24 (4.6)
	9	21 (4)
	10	98 (18.7)
	11	193 (36.8)
	12	159 (30.3)
Type of Family	Nuclear	427 (81.5)
	Joint	92 (17.6)
Class	1	19 (3.6)
	2	18 (3.4)
	3	24 (4.6)
	4	28 (5.3)
	5	109 (20.8)
	6	181 (34.5)
	7	145 (27.7)
Dietary habits	Non vegetarian	319 (60.9)
	Vegetarian	194 (37)
if consumes non- vegetarian, frequency per week	Very rarely	13 (2.5)
	once	88 (16.8)
	2-3 times	82 (15.6)
	>3	52 (9.9)
SES (modified kuppuswamy scale)	Lower middle	84 (16)
	Upper	11 (2.1)
	Upper lower	80 (15.3)
	Upper middle	256 (48.9)

Table - 2 Distribution Of General Physical Examination Findings

Physical examination	findings	Number (%)
general appearance	Normal built	410 (78.2)
	Sickly	3 (0.6)
	Thin built	98 (18.7)
hair	easily pluckable	3 (0.6)
	flag sign	2 (0.4)
	Lack of lustre	33 (6.3)

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	Normal	467 (89.1)
	thin and sparse	5 (1)
pallor	grade 1	95 (18.1)
	grade 2	26 (5)
	grade 3	4 (0.8)
	grade 4	1 (0.2)
	No pallor	386 (73.7)
lips	angular stomatitis	7 (1.3)
	cheilosis	2 (0.4)
	Normal	504 (96.2)
tongue	Fissured	3 (0.6)
	Normal	497 (94.8)
	Pale and flabby	10 (1.9)
	red and raw	1 (0.2)
teeth	caries	60 (11.5)
	mottled enamel	6 (1.1)
	Normal	445 (84.9)
Gums	bleeding	1 (0.2)
	Normal	507 (96.8)
	spongy	3 (0.6)
nails	koilonychia	2 (0.4)
	Normal	507 (96.8)

Table - 2 Mean With Sd Of Continuous Variables

Variables	Mean (SD)
age	10.66 (1.4)
height	145.39 (14.1)
weight	37.85 (10.3)
BMI = kg/m2	17.7 (3.8)
PAQ-A	2.76 (0.6)
Hours Slept	8.22 (0.9)
Hours in Bed	8.42 (0.9)
Sleep Efficiency	0.98 (0.1)
PSQI Score	2.27 (1.5)
DSC Score	269.7 (122.8)

Table – 3 Distribution Of Mean Scores Among Various Ages

Age	age vs DSC Mean (SD)
6 years	292.5 (135.56)
7 years	222.86 (99.89)
8 years	290 (116.04)
9 years	251.84 (89.18)
10 years	257.14 (149.11)
11 years	270.64 (105.25)
12 years	280.65 (131.16)
Overall	270.07 (123.26)
P	*p= 0.540

Table – 4 Distribution Of Mean Scores Among BMI Categories

BMI Categories	BMI vs DSC Mean (SD)
underweight	263.42 (120.38)
normal	276.25 (125.73)
overweight	263.27 (126.68)
obese	255.71 (79.38)
Overall	270.07 (123.26)
P	*p= 0.048

Table – 5 Pearson Correlation

Pearson rho	Age	BMI	DSC
Age	1.000	0.242	0.262
BMI categories	0.242	1.000	0.220
Class/ grade	0.973	0.254	0.054
SES	-0.140	-0.083	0.043

RESULTS:

Among the 524 children, 271 (51.7%) were male and 253 (48.3%) were female. The majority of participants were in the older age range, with 11-year-olds (193, 36.8%) and 12-year-olds (159, 30.3%) comprising the largest groups, while younger ages were less represented. Most children belonged to nuclear families (427, 81.5%), reflecting prevalent urban household structures, while 92 (17.6%) were from joint families. The frequencies of the categorical variables are presented in table 1.

Regarding educational level, the highest proportions of children were in Class 6 (181, 34.5%) and Class 7 (145, 27.7%), followed by Class 5 (109, 20.8%). Dietary habits showed that 319 (60.9%) of the children were non-vegetarian, while 194 (37%) were vegetarian. Among the non-vegetarian children, 88 (16.8%) consumed such food once a week, 82 (15.6%) consumed it 2–3 times weekly, and 52 (9.9%) consumed it more than three times per week, with only 13 (2.5%) reporting very rare intake.

In terms of nutritional status based on BMI, 370 (70.6%) children were in the normal range, while 55 (10.5%) were underweight, 64 (12.2%) were overweight, and 36 (6.9%) were obese. Socioeconomic status, assessed via the modified Kuppuswamy scale, revealed that the majority belonged to the upper middle class (256, 48.9%), followed by lower class (94, 17.9%), lower middle class (84, 16%), upper lower class (80, 15.3%), and a small proportion from the upper class (11, 2.1%).

The physical examination of the children as depicted in table 2, revealed that the majority (410, 78.2%) had a normal build, while 98 (18.7%) were thin, and only 3 (0.6%) appeared sickly. Examination of the hair showed that 467 (89.1%) had normal hair, while signs of nutritional deficiency such as lack of lustre (33, 6.3%), thin and sparse hair (5, 1%), easily pluckable hair (3, 0.6%), and flag sign (2, 0.4%) were also observed.

Pallor was noted in various grades, with 95 (18.1%) showing grade 1 pallor, 26 (5%) grade 2, 4 (0.8%) grade 3, and 1 (0.2%) grade 4, while 386 (73.7%) had no pallor. Lip examination showed angular stomatitis in 7 (1.3%) children and cheilosis in 2 (0.4%), with 504 (96.2%) having normal lips. Tongue findings were mostly normal (497, 94.8%), although 10 (1.9%) had a pale and flabby tongue, 3 (0.6%) had fissures, and 1 (0.2%) had a red and raw tongue.

Dental examination revealed caries in 60 (11.5%) and mottled enamel in 6 (1.1%), with the majority (445, 84.9%) having normal teeth. Gum examination showed that 507 (96.8%) had normal gums, while 3 (0.6%) had spongy gums and 1 (0.2%) showed bleeding. Nail examination found koilonychia in 2 (0.4%) children, while 507 (96.8%) had normal nails. These findings suggest early signs of nutritional deficiencies in a subset of the population.

The participants had a mean age of 10.7 years (SD = 1.4). Average height was 145.4 cm (SD = 14.1), with notable left-skewness, while mean weight was 37.8 kg (SD = 10.3), showing a slight right-skew. The mean BMI was 17.7 kg/m² (SD = 3.8), with a mild right-skew. Hip circumference averaged 63.9 cm (SD = 14.9), and showed significant left-skewness. The DSC score averaged 269.7 (SD = 122.8), showing a notable right-skew, reflecting high variability in screen exposure.

The analysis of mean scores across age groups revealed that screen exposure scores (DSC) varied with age but without statistical significance (p = 0.540). When comparing BMI categories (table 5), DSC scores showed a statistically significant variation with BMI (p = 0.048), with higher screen time in normal-weight children, though the differences were modest.

Pearson correlation analysis (table 6) revealed several noteworthy associations among key variables. Age demonstrated a moderate positive correlation with BMI categories (r = 0.242) and screen exposure (DSC) scores (r = 0.262), suggesting that as children grow older, their BMI and screen time tend to increase. Similarly, class or grade showed a strong positive correlation with age (r = 0.973) and a modest correlation with BMI (r = 0.254), but a weak association with screen exposure (r = 0.054), indicating that academic progression aligns closely with age but not necessarily with screen time. Socioeconomic status (SES) exhibited a weak negative correlation with both age (r = -0.140) and BMI (r = -0.083), while its correlation with screen exposure was minimal (r = 0.043), implying that SES had limited influence on these variables in this cohort.

DISCUSSION

The early years of life, particularly the first three, represent a period of extraordinary growth and change. This developmental window is marked by rapid advancements across various domains; physical, cognitive, emotional, and social (9,10). During this phase, the brain undergoes dynamic restructuring, and the foundations for future learning, behavior, and health are established. To fully realize their developmental potential, children require appropriate care, stimulation, and especially adequate nutrition. Proper nourishment during this critical period enhances not just the quality of life, but also future educational performance and economic productivity.(11)

While care not only confines to the nutritional and educational aspects, there is increasing emphasis on the social, cultural and environmental factors that exert significant influence. Physical activity, sleep and screen exposure are key factors among these. Research has highlighted strong associations between these behaviors and various physical and mental health outcomes.

The logical argument based on the metabolic and endocrine physiology is that better sleep quality and duration, and more physical activity would ensure a healthy BMI while the converse is true for the relationship between BMI and screen time. The same was elaborated by several studies conducted across the globe (12,13), although some researchers argue that these behaviors may independently influence health among adolescents (14).

Our observation that 82.27% of children come from nuclear families aligns with national trends. The National Family Health Survey (2005–06) indicated a shift towards nuclear families, though joint families still exist, especially in rural areas. Interestingly, children in non-nuclear families were found to have better nutritional status and higher immunization coverage, suggesting that extended family support can positively influence child health (15). In Germany, studies have shown that adolescents from nuclear families generally report better health outcomes compared to those from single-parent or stepfamilies (16). However, the quality of family relationships, or 'family climate,' plays a more significant role in adolescent well-being than family structure alone. As for the United States, traditional nuclear family model has declined over the past decades (17). A study highlighted that both parents working outside the home is now the most common arrangement, constituting about a third of families (18). Single-parent families, especially those headed by single mothers, are also prevalent, each comprising nearly 22-23% of families. Children in nuclear families generally exhibit better health and behavioural outcomes compared to those in single-parent families (16).

The findings of this study on school-going children regarding anthropometry and screen exposure demonstrate trends that are largely consistent with those reported in studies from India, the United States, and Europe. The observed BMI distribution—where 70.5% of children were in the normal range, 10.5% underweight, 12.2% overweight, and 6.9% obese—highlights the coexistence of under- and over-nutrition, a pattern frequently reported in urban Indian populations. Similar studies in India have documented undernutrition in rural or low-income groups and increasing overweight/obesity in urban or higher SES cohorts, comparable to the prevalence of childhood obesity in the U.S. (over 19%) and Europe (ranging from 10–20% depending on the country). (19–23)

The average daily screen time of around 270 minutes found in this study is notably higher than the AAP's recommended limit of two hours (24). This is comparable to screen use patterns reported among urban Indian children, as well as children in Europe and the U.S., where increasing screen time has been associated with reduced physical activity and sleep quality. In summary, the current data reflect a convergence of global childhood health trends—characterized by suboptimal physical activity, increasing screen exposure, and declining sleep hygiene, highlighting the urgent need for integrated school and community-based interventions to promote holistic well-being in children across diverse socioeconomic and geographic settings.

Although multiple studies established that the digital screen usage significantly increased after the onset of COVID-19 pandemic, it was also noted that the increase in screen time was not uniform among all groups of children (4,25,26). For instance, children with autism spectrum disorder (ASD) already had elevated screen time before the pandemic and the increase post pandemic was not significant. Also, children from low-income households and families facing pandemic-related financial hardships were observed to have a higher screen time (27).

Children's anthropometric outcomes are closely influenced by their physical activity levels and sedentary behaviors. Research consistently shows that higher engagement in moderate-to-vigorous physical activity (MVPA) correlates with lower BMI, reduced body fat, and smaller waist circumference, while extended sedentary time especially from screens, is linked to increased BMI and waist size (28–31). These influences are often independent; for instance, O'Brien et al. (2018) found that activity and screen time affected weight outcomes differently based on initial weight status (32). Similarly, Blanck et al. (2007) observed that physical activity reduced weight gain risk mainly in women without pre-existing overweight (33).

The study revealed comparable anthropometric measures across age groups but notable uniformity in screen time, alongside frequent clinical signs of undernutrition such as pallor and koilonychia. While no major stunting or developmental delay was observed at present, the continuation of current lifestyle habits could lead to future health deterioration. Given that the participants belonged to select schools, the researchers propose a follow-up intervention to educate them on risks of malnutrition, metabolic issues, and the importance of healthy behaviours through informative outreach.

Around 35.7% of children had at least one physical sign of undernutrition, even among those with normal BMI, underscoring the need for holistic assessment beyond anthropometry.

Findings showed significant associations between BMI and screen use. Despite IAP-recommended screen time limits of 180 minutes/week, only 12.9% met this criterion, with excessive screen use prevalent across age groups (34). These lifestyle factors may impact not just physical but cognitive and emotional development, influenced further by altered circadian rhythms and environmental exposures. Emerging global trends support these concerns: childhood obesity has increased worldwide, and menarcheal age has declined, both linked to nutritional and environmental shifts.

The study also noted no significant link between socioeconomic status and screen exposure, which was uniformly high. These observations stress the universal nature of digital overexposure, regardless of background. The authors advocate for routine assessment of screen habits during paediatric evaluations and highlight the need for targeted public health strategies to address these modifiable factors.

This study's key strengths include a robust sample size, effective use of validated tools, a meticulously drafted methodology, and careful data collection. The provision of a locally translated questionnaire improved accessibility, while prior refinement of data and handling of missing values enhanced accuracy. Efforts to verify unclear responses added credibility, though time constraints limited full follow-up. Ambiguous variables were recoded numerically for consistency in analysis. However, the study would benefit from a more detailed horizontal analysis to better understand the impact of sociodemographic factors on child development. The authors aim to explore this in future work.

CONCLUSIONS

The study revealed that 82.27% of children came from nuclear families, reflecting modern urban demographics. While 70.5% had a normal BMI, 10.5% were underweight and 19.1% overweight or obese. Despite normal growth parameters, many children exhibited high screen time, low activity, poor sleep, and signs like pallor and koilonychia, pointing to early health decline. Screen exposure (DSEQ scores) varied widely and increased slightly with age. Pearson correlation showed BMI was positively linked to screen time.The study emphasizes integrating lifestyle assessments into routine pediatric care and proposes future interventions to promote healthier habits among school-aged children.

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