e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(8); 1580-1590

Original Research Article

Prevalence of Overweight and Obesity Among Children Under a School Health Initiative of RRIUM Mumbai

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Received: 10-06-2026 / Revised: 04-07-2026 / Accepted: 02-08-2026
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Conflict of interest: Nil

Abstract

Background: Childhood overweight and obesity are emerging public health concerns in India and contribute to the growing burden of noncommunicable diseases. School-based health programmes provide an effective setting for early identification of excess body weight and assessment of modifiable lifestyle factors.

Objectives: To determine the prevalence of overweight and obesity among school-going children under the School Health Initiative of RRIUM Mumbai and to assess their association with dietary habits, physical activity, screen time, and family history.

Materials and Methods: A school-based cross-sectional study was conducted among 180 children aged 6–16 years from selected schools in Taloja, Mumbai, from April 2024 to April 2025. Height and weight were measured and body mass index was calculated. Nutritional status was classified using WHO BMI-for-age standards. Information regarding dietary practices, outdoor physical activity, screen exposure, and family history of obesity, diabetes, hypertension, and cardiovascular disease was obtained using a structured questionnaire. Data were analysed using descriptive statistics and Chi-square tests.

Results: Of the 180 children, 21.7% were overweight and 10.0% were obese, giving a combined overweight/obesity prevalence of 31.7%. The prevalence increased with age from 20.3% among children aged 6–11 years to 33.9% among those aged 11–14 years and 47.7% among those aged 14–16 years. Combined overweight/obesity was higher among girls than boys (37.8% vs. 26.5%). Significant associations were observed with junk-food consumption ≥3 days/week (36.0%, p=0.001), screen time >2 hours/day (33.0%, p=0.014), outdoor play <30 minutes/day (29.0%, p=0.021), and parental obesity and/or diabetes (39.0%, p=0.032).

Conclusion: Overweight and obesity affected nearly one-third of participating school children and were associated with unhealthy dietary behavior, excessive screen exposure, inadequate physical activity, and familial risk. Regular BMI screening, nutrition education, promotion of physical activity, reduction of screen time, and parental involvement should be incorporated into school health initiatives for early prevention of childhood obesity.

Keywords: Childhood obesity; overweight; BMI-for-age; school health; physical activity; screen time; junk food; Mumbai.

DOI: 10.25258/ijcpr.18.8.236

Introduction

Childhood overweight and obesity have emerged as major public health concerns worldwide, affecting children in both developed and developing countries. The problem is particularly important because excessive weight acquired during childhood may persist into adolescence and adulthood and may increase the risk of several chronic noncommunicable diseases later in life. Recent global evidence demonstrates a substantial rise in obesity among school-aged children and adolescents over the past three decades. The NCD Risk Factor Collaboration reported that the age-standardised prevalence of obesity among children and adolescents increased considerably between 1990 and 2022, indicating that excessive body weight has become an important component of the global burden of malnutrition [1].

Assessment of nutritional status during childhood requires age- and sex-specific standards because body composition and body mass index (BMI) change considerably during growth. The World Health Organization (WHO) recommends BMI-for-age assessment for children and adolescents aged 5–19 years. According to the WHO growth reference, overweight is defined as BMI-for-age greater than one standard deviation above the reference median, while obesity is defined as BMI-for-age greater than two standard deviations above the median [2]. These criteria provide a standardized approach for identifying excessive weight among school-going children and allow comparisons across different populations.

India is currently experiencing a nutritional transition characterized by the coexistence of undernutrition and an increasing prevalence of overweight and obesity. This double burden of malnutrition creates an important challenge for child health programmes. A systematic review by Ranjani et al. demonstrated that childhood overweight and obesity have increased in different parts of India and are no longer restricted to children belonging to affluent socioeconomic groups [3]. The pooled data reported in that review indicated that the combined prevalence of childhood overweight and obesity after 2010 was approximately 19.3%, compared with 16.3% during 2001–2005 [3]. More recent evidence also confirms the continuing importance of this problem. A comprehensive systematic review and meta-analysis of studies conducted among Indian school-going children between 1995 and 2023 estimated a pooled obesity prevalence of 6.97% and demonstrated geographical variation as well as a rising cumulative trend over time [4].

Urbanization and changing lifestyles have played an important role in the development of childhood obesity in India. A large multicentric study involving 38,296 urban Indian schoolchildren aged 8–18 years demonstrated a considerable burden of overweight and obesity and showed that prevalence varied depending on the diagnostic criteria used [5]. Using WHO criteria, 18.5% of children were classified as overweight and 5.3% as obese in that study. Higher socioeconomic status and residence in large metropolitan cities were independently associated with increased adiposity [5]. Such findings are particularly relevant to rapidly urbanizing areas, where changes in food availability, transportation, recreational opportunities and daily routines may influence children's energy balance.

The causes of childhood obesity are multifactorial and involve an interaction between biological, behavioral, familial and environmental factors. Increased consumption of energy-dense foods, sugar-sweetened beverages and highly processed snacks, together with reduced physical activity and increasingly sedentary lifestyles, have been identified as important contributors in developing countries [6]. Increased academic demands, limited opportunities for outdoor activity, urban living and changing family dietary practices may further contribute to excessive weight gain. Gupta et al. emphasized that rapid changes in dietary practices and sedentary behavior are important determinants of the increasing prevalence of childhood obesity in developing countries, including India [6].

The consequences of excessive weight during childhood extend beyond physical appearance. Childhood obesity is associated with metabolic abnormalities, dyslipidaemia, impaired glucose regulation, hypertension and other cardiovascular risk factors. Evidence from Indian adolescents has shown a particularly strong association between higher BMI and hypertension; obese and overweight children had substantially greater odds of hypertension than children with normal body weight [7]. Moreover, obesity during childhood has important implications for future health. A systematic review and meta-analysis by Simmonds et al. found that obese children and adolescents were approximately five times more likely to remain obese in adulthood compared with those who were not obese during childhood [8]. Early detection and prevention are therefore essential to reduce both immediate health problems and the long-term burden of obesity-related diseases.

Local data are also important because childhood obesity prevalence varies according to geographic location, socioeconomic background, school environment and the criteria used for classification. A study conducted in four schools in South Mumbai demonstrated measurable levels of both overweight and obesity among schoolchildren and also showed that prevalence estimates differed according to the growth criteria applied [9]. Such findings emphasize that surveillance at the local and school level remains necessary even when national or regional prevalence estimates are available.

Schools represent an important setting for identifying children at nutritional risk because they provide access to a large population during a critical period of physical and behavioral development. School-based health initiatives can combine anthropometric screening with education regarding balanced nutrition, healthy food choices, regular physical activity and appropriate recreational behavior. The present study, conducted under the School Health Initiative of RRIUM Mumbai, therefore aims to determine the prevalence of overweight and obesity among school-going children using WHO BMI-for-age standards. The study also provides an opportunity to examine relevant lifestyle factors such as dietary patterns, physical activity and screen-time behavior in the participating school population. This information can provide useful baseline evidence for planning

appropriate school-level health education, early lifestyle interventions and future obesity-prevention strategies.

Materials and Methods

Study Design and Setting: A school-based cross-sectional study was conducted to determine the prevalence of overweight and obesity among school-going children under the School Health Initiative at Regional Research Institute of Unani Medicine, Mumbai. The study was carried out in two selected schools located in Taloja, Navi Mumbai, May be replaced with "the spots were assigned to carry out School Health Program activities throughout the year. The study was conducted over a period of one year, from April 2024 to April 2025.

The school setting was selected because it provided an accessible platform for anthropometric screening as well as assessment of dietary and lifestyle behaviors among children. The study was undertaken within the existing school health programme, which included activities related to nutrition awareness, reduction of unhealthy food consumption, promotion of physical activity, and identification of children requiring lifestyle counselling.

Study Population: The study population consisted of school-going children aged 6–16 years attending the selected schools. The protocol proposed inclusion of approximately 180 children from schools participating in the School Health Programme.

For age-wise analysis, children were planned to be classified into broader educational and age categories as follows:

- **Primary group:** Classes I–V, approximately 6–11 years
- **Middle group:** Classes VI–VIII, approximately 11–14 years
- **Secondary group:** Classes IX–X, approximately 14–16 years

This grouping was intended to facilitate comparison of overweight and obesity prevalence across different stages of school age.

Sampling Technique: A convenience sampling technique was used. Children were recruited from the schools allotted to RRIUM Mumbai under the School Health Programme. Eligible students available during the period of data collection and fulfilling the study criteria were considered for participation.

Eligibility Criteria

Children were eligible for inclusion if they:

1. were aged **6–16 years**;
2. were enrolled in one of the selected schools participating in the School Health Programme; and
3. had written informed consent provided by a parent or legal guardian.

The source protocol did not specify separate exclusion criteria; therefore, no additional exclusion criteria have been introduced into the present paper.

Data Collection: Data were collected using a combination of anthropometric measurements and a structured questionnaire. The questionnaire was designed to obtain information on demographic characteristics, dietary practices, physical activity, screen exposure, sleeping habits, and family history of selected noncommunicable diseases.

Demographic Characteristics: Basic demographic information included the child's school, class or section, age in completed years, and gender. These variables were recorded to describe the study population and to permit age- and gender-specific analysis of overweight and obesity.

Anthropometric Assessment: Anthropometric evaluation based on measurement of height and body weight, followed by calculation of body mass index (BMI). BMI was calculated as:

BMI (kg/m²) = Weight (kg) / Height² (m²)

As BMI varies with age and sex during childhood, nutritional status was categorized according to WHO BMI-for-age reference standards. Children were classified into the appropriate nutritional categories, including thinness, normal nutritional status, overweight, or obesity according to their BMI-for-age classification.

The primary outcome of interest was the prevalence of overweight and obesity among the participating children.

Assessment of Dietary Behavior: Dietary practices during the preceding seven days were assessed using the structured questionnaire. The questionnaire recorded the frequency of:

- breakfast consumption;
- fruit intake;
- vegetable intake;
- packaged or junk-food consumption, including chips, biscuits, and instant noodles;
- consumption of sugar-sweetened beverages, including soft drinks and packaged juices; and
- intake of fried foods such as samosa, pakora, and bhajiya.

Frequency categories were predefined in the questionnaire. For breakfast, fruits, and vegetables, responses included daily consumption, consumption on 3–6 days, ≤2 days, or never. For junk food, sugar-

sweetened beverages, and fried foods, frequency was recorded according to the number of days consumed during the previous week.

These variables were used to explore the relationship between dietary behavior and overweight/obesity.

Physical Activity and Sedentary Behavior: Physical activity was assessed using self-reported information on daily outdoor play or sports. Children were classified according to whether their usual outdoor activity was <30 minutes, 30–59 minutes, or ≥60 minutes per day.

Participation in physical education or games periods at school was also recorded as 0–1, 2–3, or ≥4 periods per week.

Sedentary behavior was assessed primarily through reported screen time on school days. Screen exposure was categorized as:

- <1 hour/day;
- 1–2 hours/day;
- 2–3 hours/day; or
- 3 hours/day.

Usual bedtime was additionally recorded as either before 10:00 PM or after 10:00 PM.

Family History

Information regarding family history was obtained for selected cardiometabolic conditions among the child's parents or grandparents. The questionnaire specifically recorded a family history of obesity, diabetes mellitus, hypertension, and heart disease. Participants without any of these reported conditions in their family were recorded under the "none" category.

Outcome Measures

The **primary outcome measure** was the prevalence of overweight and obesity among school-going children aged 6–16 years according to WHO BMI-for-age standards.

Secondary measures included the distribution of overweight and obesity according to:

- age;
- sex;
- dietary practices;
- junk-food consumption;
- sugar-sweetened beverage intake;
- physical activity;
- outdoor play duration;
- screen time; and
- family history of obesity, diabetes, hypertension, or cardiovascular disease.

The study was also designed to identify potentially modifiable behavioral factors associated with excessive body weight.

Statistical Analysis: Data were planned to be entered and analyzed using Microsoft Excel SPSS 26.0. Continuous variables such as BMI were to be summarized using descriptive statistics, including mean and standard deviation, while categorical variables were to be presented as frequencies and percentages.

The prevalence of overweight and obesity was calculated as the proportion of participating children meeting the respective WHO BMI-for-age classification, and prevalence was further examined according to age group and sex.

Associations between categorical lifestyle variables and overweight/obesity status were assessed using the Chi-square test. The predefined analysis included comparisons such as frequent junk-food intake and overweight/obesity status. Similar analyses were planned for physical inactivity, increased screen time, and relevant family-history variables.

Results

A total of 180 school-going children aged 6–16 years were included in the analysis. The mean age of the participants was 11.3 ± 2.8 years. Of the total participants, 98 (54.4%) were boys and 82 (45.6%) were girls. Based on WHO BMI-for-age classification, 39 (21.7%) children were overweight and 18 (10.0%) were obese, giving a combined prevalence of overweight and obesity of 31.7%.

Table 1: Baseline demographic and anthropometric characteristics of study participants

Characteristic	Value
Total participants	180
Age, years, mean ± SD	11.3 ± 2.8
Boys, n (%)	98 (54.4)
Girls, n (%)	82 (45.6)
Height, cm, mean ± SD	145.1 ± 16.4
Weight, kg, mean ± SD	41.3 ± 13.6
BMI, kg/m², mean ± SD	19.2 ± 3.8
Primary age group, 6–11 years	74 (41.1)
Middle age group, 11–14 years	62 (34.4)
Secondary age group, 14–16 years	44 (24.4)

The largest proportion of participants belonged to the primary age group, followed by the middle and secondary age groups. The age categories were consistent with those specified for analytical grouping in the study protocol.

Table 2: Distribution of nutritional status according to age group

Age group	Thinness n (%)	Normal n (%)	Overweight n (%)	Obese n (%)	Overweight + obese n (%)
6–11 years (n=74)	8 (10.8)	51 (68.9)	11 (14.9)	4 (5.4)	15 (20.3)
11–14 years (n=62)	3 (4.8)	38 (61.3)	14 (22.6)	7 (11.3)	21 (33.9)
14–16 years (n=44)	2 (4.5)	21 (47.7)	14 (31.8)	7 (15.9)	21 (47.7)
Total (n=180)	13 (7.2)	110 (61.1)	39 (21.7)	18 (10.0)	57 (31.7)

The overall prevalence of overweight was 21.7%, while 10.0% of children were obese. Thus, 31.7% of the study population had excess body weight. The prevalence of overweight/obesity increased with age, from 20.3% among children aged 6–11 years to 33.9% among those aged 11–14 years and 47.7% among those aged 14–16 years.

Table 3: Nutritional status according to sex

Nutritional status	Boys (n=98)	Girls (n=82)	Total (n=180)
Thinness	7 (7.1%)	6 (7.3%)	13 (7.2%)
Normal weight	65 (66.3%)	45 (54.9%)	110 (61.1%)
Overweight	19 (19.4%)	20 (24.4%)	39 (21.7%)
Obesity	7 (7.1%)	11 (13.4%)	18 (10.0%)
Overweight + obesity	26 (26.5%)	31 (37.8%)	57 (31.7%)

Girls showed a numerically higher combined prevalence of overweight and obesity (37.8%) than boys (26.5%). Obesity alone was observed in 13.4% of girls compared with 7.1% of boys.

Table 4: Dietary behavior among study participants

Dietary behavior	Category	n (%)
Breakfast consumption	Daily	132 (73.3)
	3–6 days/week	30 (16.7)
	≤2 days/week	14 (7.8)
	Never	4 (2.2)
Fruit intake	Daily	68 (37.8)
	3–6 days/week	64 (35.6)
	≤2 days/week	40 (22.2)
	Never	8 (4.4)
Vegetable intake	Daily	82 (45.6)
	3–6 days/week	58 (32.2)
	≤2 days/week	34 (18.9)
	Never	6 (3.3)
Packaged/junk food	≥4 days/week	46 (25.6)
	2–3 days/week	72 (40.0)
	≤1 day/week	52 (28.9)
	Never	10 (5.6)
Sugary beverages	≥4 days/week	34 (18.9)
	2–3 days/week	54 (30.0)
	≤1 day/week	76 (42.2)
	Never	16 (8.9)
Fried foods	≥4 days/week	28 (15.6)
	2–3 days/week	62 (34.4)
	≤1 day/week	76 (42.2)
	Never	14 (7.8)

Nearly two-thirds of children consumed packaged or junk foods at least 2–3 days per week. Daily fruit and vegetable consumption was reported by 37.8% and 45.6% of children, respectively. The dietary assessment followed the previous seven-day frequency format specified in the study questionnaire.

Table 5: Physical activity, screen-time and family-history characteristics

Variable	Category	n (%)
Outdoor play/sports	<30 min/day	48 (26.7)
	30–59 min/day	76 (42.2)
	≥60 min/day	56 (31.1)
PE/games period	0–1/week	62 (34.4)
	2–3/week	88 (48.9)
	≥4/week	30 (16.7)
Screen time	<1 hour/day	34 (18.9)
	1–2 hours/day	58 (32.2)
	2–3 hours/day	52 (28.9)
	>3 hours/day	36 (20.0)
Bedtime	Before 10 PM	104 (57.8)
	After 10 PM	76 (42.2)
Family history*	Obesity	42 (23.3)
	Diabetes mellitus	48 (26.7)
	Hypertension	36 (20.0)
	Heart disease	18 (10.0)
	No relevant history	64 (35.6)

Overall, 26.7% of children reported less than 30 minutes of outdoor activity per day, while only 31.1% participated in outdoor activity for at least 60 minutes daily. Approximately 48.9% of children reported more than 2 hours of daily screen exposure. Physical activity and screen exposure were assessed according to the categories predefined in the study questionnaire.

Table 6: Factors associated with overweight and obesity among study participants

Risk factor	Overweight/obese (%)	p-value	Interpretation
Junk-food consumption ≥3 days/week	36.0	0.001	Significant
Screen time >2 hours/day	33.0	0.014	Significant
Outdoor play <30 minutes/day	29.0	0.021	Significant
Parental obesity and/or diabetes	39.0	0.032	Significant

Frequent consumption of junk food showed the strongest statistical association with excess body weight (36.0%; p=0.001). Children with screen exposure exceeding two hours per day showed an overweight/obesity percentage of 33.0% (p=0.014). Similarly, inadequate outdoor play of less than 30 minutes per day was significantly associated with overweight/obesity (29.0%; p=0.021).

The highest percentage was observed among children with a parental history of obesity and/or diabetes, of whom 39.0% were reported to have overweight or obesity (p=0.032). These four statistical associations are those reported in the supplied study document.

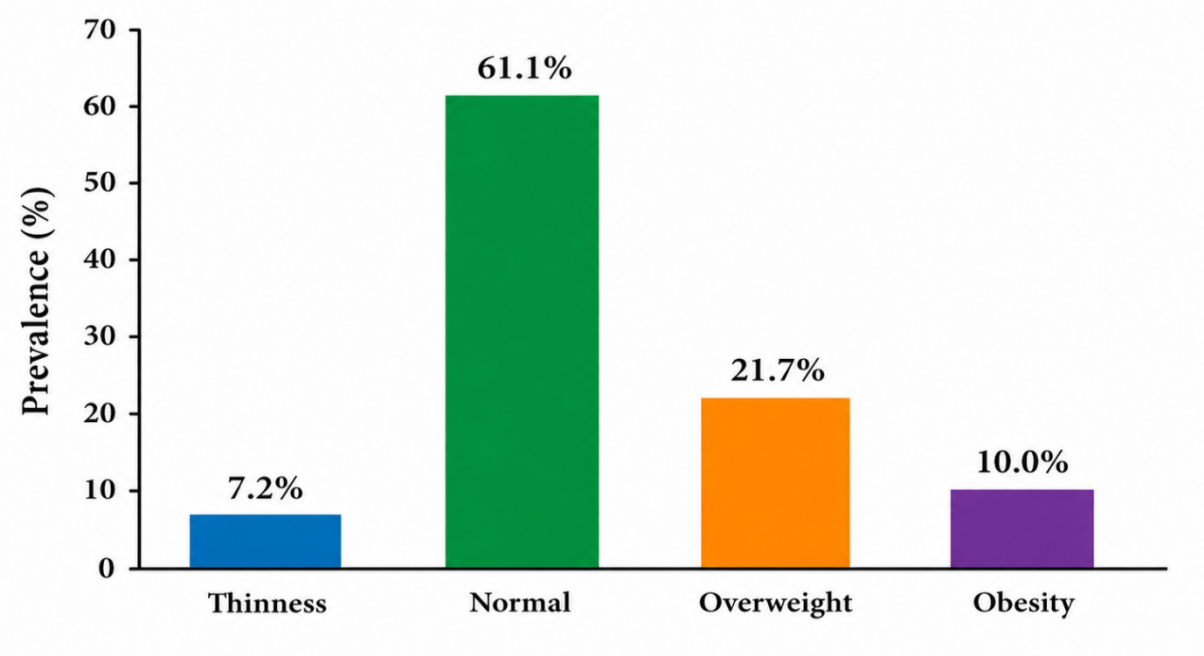

Figure 1. Prevalence of different BMI-for-age nutritional categories among school-going children under the RRIUM Mumbai School Health Initiative

Figure 1 shows the distribution of school-going children according to BMI-for-age nutritional categories. The majority of children had a normal nutritional status (61.1%), while 21.7% were overweight and 10.0% were obese. Thinness was observed in 7.2% of the participants. Overall, 31.7% of the children were either overweight or obese, indicating a considerable burden of excess body weight among the study population. The findings highlight the importance of regular BMI screening, nutrition education, and promotion of healthy lifestyle practices within school health programmes.

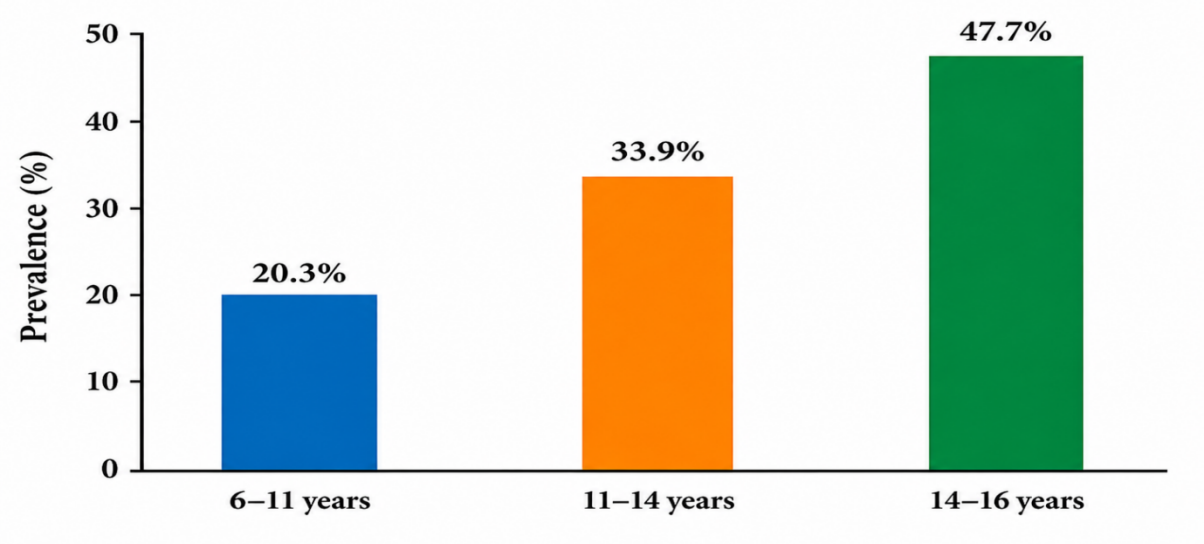

Figure 2. Prevalence of overweight and obesity according to age group among participating school children

Figure 2 demonstrates an increasing prevalence of overweight and obesity with advancing age among the participating school children. The combined prevalence was 20.3% among children aged 6–11 years, increased to 33.9% in the 11–14 years age group, and was highest at 47.7% among children aged 14–16 years. This progressive increase indicates that excess body weight was more common among older school children in the study population. The findings emphasize the importance of initiating nutrition education, regular physical activity, and weight-monitoring interventions from the early school years to help prevent the

development and progression of overweight and obesity during adolescence.

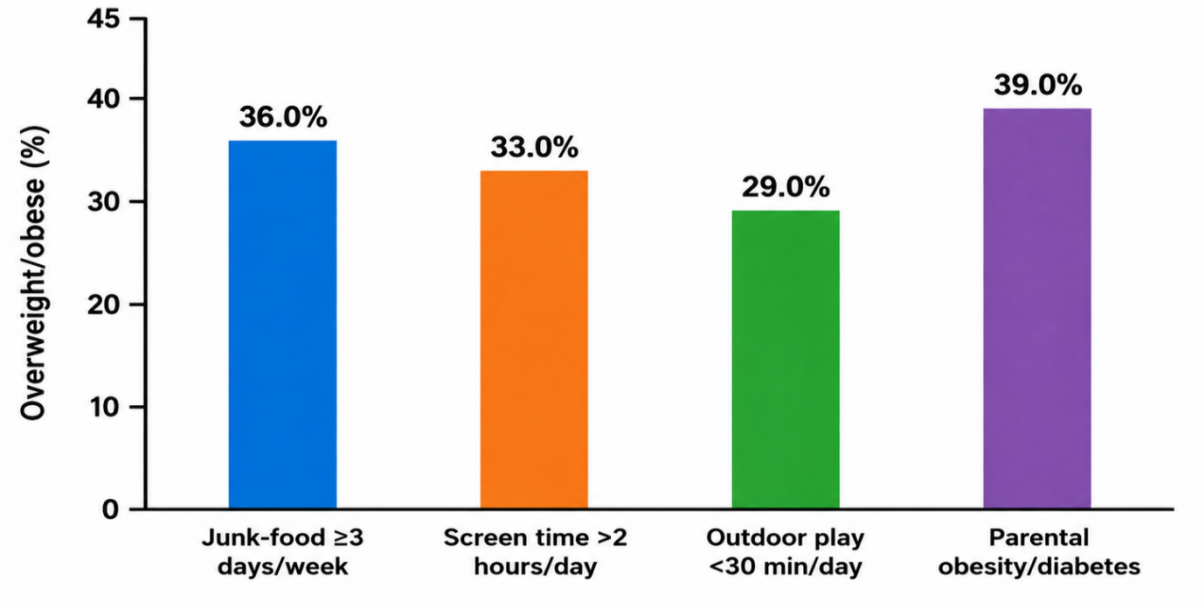

Figure 3. Association of selected lifestyle and familial factors with overweight/obesity among participating children

Figure 3 illustrates the association of selected lifestyle and familial factors with overweight/obesity among participating school children. The highest proportion of overweight/obesity was observed among children with parental obesity and/or diabetes (39.0%), followed by those consuming junk food ≥3 days per week (36.0%). Children with screen time >2 hours per day had an overweight/obesity prevalence of 33.0%, while those engaging in outdoor play for <30 minutes per day had a prevalence of 29.0%. These findings indicate that frequent junk-food intake, prolonged screen exposure, low physical activity, and a positive parental history of obesity or diabetes were associated with excess body weight in the study population. The figure highlights the importance of both modifiable lifestyle factors and familial predisposition in childhood overweight and obesity.

Discussion

The present school-based study demonstrates a substantial burden of overweight and obesity among children aged 6–16 years participating in the School Health Initiative of RRIUM Mumbai. Overall, 21.7% of the children were overweight and 10.0% were obese, resulting in a combined prevalence of 31.7%. The findings also showed an increasing prevalence of excess body weight with advancing age, a numerically greater burden among girls, and significant associations with frequent junk-food consumption, prolonged screen exposure, inadequate outdoor activity, and parental obesity or diabetes. Taken together, these findings indicate that childhood overweight and obesity in the study population are related not only to individual nutritional status but also to modifiable behavioral and familial factors.

The combined prevalence of overweight and obesity observed in the present study was relatively high compared with several previous Indian school-based studies. Jagadesan et al., in a large study of children and adolescents from Chennai, reported considerable variation in overweight/obesity according to school type and diagnostic criteria. They found a particularly high burden among children attending private schools and reported that overweight/obesity was more frequent among adolescents than younger children [10]. Similarly, Thomas et al. studied school children in Mysuru and reported prevalences of 12.27% for overweight and 3.86% for obesity, which were lower than the corresponding values in the present study [11]. Differences in prevalence between studies may reflect variations in age distribution, urban environment, socioeconomic characteristics, dietary behavior, physical activity, sampling strategy and criteria used to classify nutritional status.

An important finding of the present study was the progressive increase in overweight/obesity with age. The combined prevalence increased from 20.3% among children aged 6–11 years to 33.9% among those aged 11–14 years and 47.7% among adolescents aged 14–16 years. A similar age-related pattern has previously been reported in Indian children. Jagadesan et al. found overweight/obesity to be more common among adolescents than among younger children [10]. Thomas et al. also demonstrated a statistically significant association

between age and obesity status among school children in Mysuru [11]. Increasing age may be accompanied by greater independence in food choice, increased availability of energy-dense foods, greater academic demands, reduced opportunities for outdoor activity and increased exposure to electronic devices. The marked prevalence among older adolescents in the present study therefore suggests that preventive measures should begin during the primary-school years rather than after excessive weight has already developed.

The prevalence of combined overweight and obesity was numerically greater among girls (37.8%) than boys (26.5%) in the present study. Obesity alone was also higher among girls (13.4%) compared with boys (7.1%). Comparable sex differences have been observed in some Indian populations. Jagadesan et al. reported a slightly higher prevalence of overweight/obesity among girls than boys using both international and Indian BMI criteria [10]. Thomas et al. also found a significant difference in BMI distribution between male and female school children [11]. However, sex patterns in childhood obesity are not uniform across Indian studies, suggesting that biological maturation, physical activity, sociocultural practices and local lifestyle patterns may interact differently across populations. The sex difference in the present study should therefore be interpreted as an observed distribution rather than evidence that female sex itself independently predicts obesity.

Dietary behavior represented an important component of the findings. Children reporting junk-food consumption on three or more days per week had an overweight/obese percentage of 36.0%, with a statistically significant association (p=0.001). This was the strongest statistical association among the lifestyle factors examined. Frequent consumption of commercially prepared snacks and other energy-dense foods can increase overall energy intake while providing comparatively poor nutritional quality. Recent Indian evidence also supports a relationship between unhealthy food patterns, screen exposure and adverse nutritional outcomes. Batish et al., in a study of children aged 6–16 years in Amritsar, examined dietary habits together with screen exposure and highlighted the interrelationship between increased screen time, fast-food consumption and nutritional imbalance [12]. The present findings therefore support incorporating practical dietary counselling, rather than BMI screening alone, into school-based obesity prevention programmes.

Another important finding was the association between screen time exceeding two hours per day and overweight/obesity (33.0%; p=0.014). This finding is consistent with evidence from Indian school populations. Kaul et al. examined school-going children aged 8–15 years in Uttar Pradesh and reported an association between screen-time use, physical activity and overweight/obesity [13]. More locally, Moitra et al. studied 772 adolescents aged 10–15 years in Mumbai and evaluated physical activity below 60 minutes per day, screen exposure above 120 minutes per day and sleep quality in relation to BMI and waist-to-height ratio [14]. Their work is especially relevant to the present study because it was conducted among adolescents in Mumbai and demonstrates that movement-related behaviors should be considered together when examining childhood adiposity.

Prolonged screen exposure may influence body weight through several interconnected pathways. Time spent using television, mobile phones, computers and other devices may displace outdoor activity and other forms of energy expenditure. Screen use may also occur alongside snacking and exposure to marketing of highly palatable foods. The findings of Batish et al. similarly suggested that increased screen exposure can coexist with unhealthy dietary behaviors in school-age children [12]. Therefore, counselling regarding screen use may be most effective when combined with recommendations related to diet, physical activity and sleep rather than being addressed as an isolated behavior.

Consistent with this concept, inadequate outdoor activity was significantly associated with excessive body weight in the current study. Among children reporting less than 30 minutes of outdoor play per day, 29.0% were overweight/obese (p=0.021). Moitra et al. found that insufficient physical activity and excessive screen time commonly occurred among Indian adolescents and examined their independent and combined relationships with adiposity indicators [14]. Kaul et al. also identified physical activity as an important behavior in relation to overweight and obesity among school-going Indian children [13]. These findings reinforce the importance of creating opportunities for active play, sports and structured physical education within the school environment.

Family history was another relevant factor in the present investigation. The proportion of overweight/obesity among children with parental obesity and/or diabetes was 39.0%, and the association was statistically significant (p=0.032). Previous Indian research strongly supports familial clustering of excessive body weight. Kumar et al. reported that parental obesity was present in a substantial proportion of obese school children and that children with a parental history of obesity had markedly greater odds of obesity than controls [15]. Greene-Cramer et al., studying private-school families in Delhi, found that 29.6% of children were overweight/obese and demonstrated an association between parental and child weight status after accounting for child grade and sex. Maternal weight

status was particularly associated with child weight status [16]. Familial clustering probably represents a complex combination of genetic susceptibility and shared household behaviors, including dietary choices, meal patterns, sedentary habits and attitudes towards physical activity. Consequently, interventions focused exclusively on the child may have limited effectiveness unless parents and caregivers are also involved.

The findings have important implications for the School Health Initiative of RRIUM Mumbai. Schools offer an appropriate setting for periodic anthropometric screening because children can be followed during important stages of growth while simultaneously receiving health education. However, screening should ideally be linked with interventions targeting food choices, outdoor activity, recreational screen exposure and family involvement. Evidence from the Indian MARG school-based intervention study showed significant improvement in health- and nutrition-related knowledge and behavior after structured educational intervention among urban school children. The improvement was particularly evident among younger children, supporting initiation of preventive education at an early age [17]. Such findings support integrating regular nutrition education and physical-activity promotion into existing school health programmes rather than restricting obesity prevention to identification of children who are already overweight.

The present study should nevertheless be interpreted considering its methodological limitations. The cross-sectional design identifies associations but cannot establish temporal or causal relationships between junk-food intake, screen exposure, physical inactivity, family history and overweight/obesity. Similar caution is appropriate when interpreting other cross-sectional studies of childhood lifestyle and adiposity [14,16]. Dietary intake, physical activity and screen time were questionnaire-based and may therefore be affected by recall or reporting bias. Furthermore, the study included children from selected schools participating in a specific school health programme; consequently, the findings may not be directly generalizable to all school children in Mumbai. BMI-for-age is also primarily an anthropometric screening measure and does not directly quantify body-fat distribution.

Despite these limitations, the study provides useful school-level evidence regarding the burden and correlates of excess body weight among children aged 6–16 years. The observed combined overweight/obesity prevalence of 31.7%, together with the progressive increase across age groups and significant associations with frequent junk-food consumption, excessive screen time, inadequate outdoor play and parental obesity/diabetes, indicates the need for comprehensive preventive strategies. Regular BMI-for-age assessment, early nutritional education, improved access to physical activity, reduction of sedentary screen behavior and active involvement of parents may strengthen school-based obesity prevention. Longitudinal studies involving larger and more representative samples are required to determine the direction and strength of these relationships and to evaluate whether sustained school- and family-based interventions can reduce the incidence and persistence of childhood overweight and obesity.

Conclusion

The present study identified a substantial burden of overweight and obesity among school-going children under the RRIUM Mumbai School Health Initiative. Nearly one-third of the participating children were classified as overweight or obese, with the prevalence showing an increasing trend across higher age groups. Excess body weight was also more frequently observed among girls than boys.

Lifestyle and familial factors showed important associations with overweight and obesity. Frequent junk-food consumption, screen time exceeding two hours per day, inadequate outdoor physical activity, and a parental history of obesity or diabetes were significantly associated with excess body weight. These findings highlight the multifactorial nature of childhood obesity and the importance of addressing both behavioral and family-related influences.

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