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Original Article

Assessment of Prevalence of Obesity with associated risk factors among school-going children attending a tertiary care hospital of West Bengal: A cross-sectional study.

Dr. Salma Pervin¹, Dr. Gauranga Biswas², Dr. Muazzem Kamal Afrose¹, Dr. Sushama Sahoo^{3*}

¹Post Graduate Trainee, Department of Paediatrics, Malda Medical College, Malda, West Bengal, India.

²Associate Professor, Department of Paediatrics, Malda Medical College, Malda, West Bengal, India.

³Associate Professor and Head, Department of Paediatrics, Malda Medical College, Malda, West Bengal, India.

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Abstract

Background

Childhood obesity is a growing public-health concern, driven by rapid lifestyle transitions and environmental factors. This study aimed to estimate the prevalence of obesity and identify associated risk factors among school-going children attending a tertiary care hospital in West Bengal.

Methods

A cross-sectional study was conducted among 300 children aged 6–12 years at Malda Medical College from July 2023 to June 2024. Anthropometric measurements were obtained, and BMI-for-age was interpreted using WHO and CDC references. Sociodemographic data, dietary habits, physical activity, screen-time patterns, sleep duration, and family history were assessed using a structured questionnaire. Statistical analysis was performed using SPSS 21.0, applying Chi-square tests with $p < 0.05$ as significant.

Results

According to the WHO BMI-for-age criteria, 15% of children were obese and 20% overweight; CDC charts classified 14.3% as obese and 17.7% as overweight. The mean age was 9.1 years, with boys comprising 52% of participants. Most children belonged to middle or upper-middle socioeconomic strata. Obesity was significantly higher among boys (19.9%) than girls (10.4%). Inadequate physical activity (<60 minutes/day) and excessive screen time (>2 hours/day) were strongly associated with obesity ($p < 0.05$). Frequent fast-food intake, upper socioeconomic status, higher skinfold thickness, and positive family history were key contributors. Exclusive breastfeeding for six months showed a protective effect. Common comorbidities observed among obese children included hypothyroidism, fatty liver, hypertension, asthma, and dyslipidaemia.

Conclusion

Childhood obesity in this setting is closely linked to modifiable lifestyle factors, particularly limited physical activity, excessive screen exposure, and high-calorie dietary patterns. Early identification and targeted interventions are essential to prevent long-term metabolic risks.

Recommendations

Strengthening school- and community-based programmes that promote daily physical activity, balanced diets, reduced screen time, and parental involvement is crucial.

Keywords: Childhood obesity, Risk factors, Physical inactivity, Screen time, Dietary habits, School children

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Corresponding author: Dr. Sushama Sahoo*

Email: sushamasahoo@gmail.com

Associate Professor and Head, Department of Paediatrics, Malda Medical College, Malda, West Bengal, India.

Introduction

Obesity, derived from the Latin term *obesitas*, meaning “stout, fat, or plump,” originates from *ēsus*, the past participle of

edere (to eat), combined with the prefix *ob* meaning “over” [1]. While “overweight” refers to an excess of body weight relative to height, “obesity” specifically denotes an abnormal or excessive accumulation of body fat beyond physiological



needs [2]. Childhood obesity has emerged as a major precursor to several non-communicable diseases and represents one of the most prevalent nutritional disorders among children and adolescents worldwide [3,4]. Traditionally, malnutrition was synonymous with undernutrition and poverty; however, the global shift toward urbanization and higher living standards has transformed overnutrition—manifesting as overweight and obesity—into a critical health concern [5].

In recent decades, the prevalence of childhood obesity has increased alarmingly, constituting a global epidemic with profound public health implications. The past two decades have witnessed a threefold rise in obesity prevalence in the United Kingdom alone, exemplifying the rapidity of this transition [6]. Sedentary behaviour and excessive consumption of calorie-dense, nutrient-poor foods are recognized as key contributors to this escalating trend [7]. Obesity arises from an imbalance between caloric intake and energy expenditure, leading to disproportionate fat deposition and impaired growth regulation. Although its etiology is multifactorial, modifiable determinants—such as poor dietary patterns, physical inactivity, and sedentary lifestyle—remain central to its pathogenesis. The modern environment, characterized by easy access to fast foods, larger portion sizes, frequent intake of sugary beverages, and minimal physical activity, has further accelerated this epidemic [8]. Additionally, increased use of electronic devices—television, smartphones, and video games—has restricted outdoor activities, disrupted circadian rhythms, and promoted unhealthy snacking behaviours [9].

Children who are overweight are more likely to remain obese into adulthood, predisposing them to chronic conditions such as diabetes, hypertension, cardiovascular disease, and psychosocial disorders [10,11]. Globally, obesity accounts for over 2.6 million deaths each year [12]. As of 2018, approximately 20.3% of children aged 6–12 years were obese worldwide, with India ranking second only to China, accounting for nearly 14.4 million obese children [13]. Beyond individual health risks, the burden of childhood obesity extends to healthcare systems through increased medical costs and diminished productivity [14].

Childhood obesity results from a complex interplay of genetic, behavioural, and environmental influences. While hereditary predisposition contributes, the rapid escalation of obesity in recent decades highlights the predominant role of modifiable lifestyle and environmental factors—particularly increased consumption of high-calorie foods and reduced physical activity [15]. The modern “obesogenic” environment, reinforced by sedentary behaviours, prolonged screen exposure, and aggressive marketing of processed foods, continues to promote excessive weight gain among children [16].

Given these challenges, the present study was undertaken to determine the prevalence of obesity and explore its associated

risk factors among schoolchildren attending a tertiary care hospital. The objectives were to:

Determine the prevalence of obesity among school-going children.

Identify key risk factors, including dietary habits, physical activity, socioeconomic status, family history of obesity, screen time, and birth weight.

Analyse the relationship between these factors and the prevalence of obesity to guide evidence-based prevention strategies and inform public health policy.

Materials and methodology

Study design

The present research was structured as an institution-based observational study employing a cross-sectional design. This methodological approach was selected to assess the prevalence of obesity and its associated risk factors among school-going children within a defined population at a single point in time. The design enabled systematic data collection on anthropometric, behavioural, and sociodemographic variables, allowing statistical analysis of associations between obesity and relevant determinants.

Study setting and duration

The study was conducted in the Department of Paediatrics, Malda Medical College and Hospital (MMCH), a major tertiary-care teaching institution in northern West Bengal. The hospital is a referral centre for surrounding rural and semi-urban districts and caters to a large paediatric population through its outpatient, inpatient, and emergency services. The institution has a dedicated Paediatrics department with specialized clinics, a high outpatient turnout, and facilities for comprehensive growth and nutritional assessment. This diverse catchment and high patient volume provided an appropriate setting for evaluating the burden of childhood obesity among school-going children. The study was carried out over 12 months from July 2023 to June 2024.

Study population

All school-going children aged 6 to 12 years, either admitted to the paediatric ward or attending the paediatric OPD at Malda Medical College and Hospital, were included in the study population.

Sample size

A total sample size of 300 was selected based on the average monthly outpatient attendance and admission statistics of the Paediatrics department. Previous regional studies have



reported childhood obesity prevalence ranging from 10% to 20%. Using an anticipated prevalence of 15%, a 95% confidence level, and an allowable error of 5%, the minimum required sample size was approximately 196. To improve representativeness and ensure sufficient power for subgroup analyses related to risk factors, the sample was increased to 300. This size was feasible within the one-year study period and allowed for adequate precision in estimating prevalence.

Inclusion criteria

Children aged 6–12 years admitted to the paediatric ward or attending the paediatric OPD.

Exclusion criteria

Critically ill children who could not undergo anthropometric assessment were also excluded. Children with chronic conditions known to significantly affect growth patterns, such as congenital endocrine disorders, chronic renal disease, or long-term corticosteroid therapy, were excluded to avoid confounding of obesity-related outcomes.

Efforts to minimise bias

Several steps were taken to reduce potential sources of bias. Selection bias was minimized by including consecutive eligible children attending both OPD and inpatient services during the study period. Information bias was addressed by using a structured questionnaire administered by trained investigators and standardizing anthropometric measurements with calibrated instruments. Recall bias related to diet, sleep, and physical activity was reduced by prompting caregivers with simple, time-anchored questions. Measurement bias was minimized through uniform protocols for height, weight, waist–hip ratio, and skinfold thickness, with repeated readings taken where necessary. Confounding was limited by analysing key variables such as socioeconomic status, family history, and lifestyle factors in the statistical model.

Data collection

Data were collected using a structured proforma covering the following parameters:

Name
Age
Sex
Residence
Type of family
Per capita income
Socioeconomic status
Weight (kg)
Expected weight for age (kg)
Height (cm)
Body Mass Index (BMI)
Waist–hip ratio
Skinfold thickness
History of exclusive breastfeeding
Birth order
Physical activity
Screen time
Adequate sleep
Fast food consumption
Family history of obesity

Socioeconomic and anthropometric parameters

1. Per capita income

Socioeconomic status was determined using the Modified BG Prasad Classification (January 2024 update), a widely accepted socioeconomic scale in India. It is based on the Consumer Price Index for Industrial Workers (CPI–IW) published by the Labour Bureau, Government of India, and accounts for variations in the cost of essential goods such as food, clothing, housing, fuel, and miscellaneous items.

Table 1. Modified BG Prasad classification for socioeconomic status (2024)

Social Class	Original BG Prasad Classification (1961) (₹/month)	Modified BG Prasad Classification (January 2024) (₹/month)
Upper class	≥ 100	≥ 9,098
Upper middle class	50–99	4,549–9,097
Middle class	30–49	2,729–4,548
Lower middle class	15–29	1,364–2,728
Lower class	< 15	< 1,364

Anthropometric measurements

2. Weight measurement

Weight was measured using a calibrated digital weighing scale.

Procedure

The scale was turned on and set to zero.
Children were weighed barefoot and in light clothing.
The child stood upright at the center of the platform without support.
The weight was recorded to the nearest 0.1 kg.

Common sources of error

- Movement during measurement.
- Holding onto the caregiver or nearby support.
- Wearing footwear or heavy clothing.
- Incorrect calibration or placement of the scale.

3. Height measurement

Height was measured using a stadiometer/anthropometer.

Procedure

The child stood barefoot, upright with heels, buttocks, shoulders, and occiput touching the wall.
The head was positioned in the Frankfurt horizontal plane.
A flat wooden headpiece was brought down to touch the crown of the head, and the height was read to the nearest 0.1 cm.

Common sources of error

- Improper positioning (bent knees, tilted head).
- Footwear or bulky clothing not removed.
- Inaccurate zero alignment.

4. Expected weight for age (Weech's Formula)

Expected body weight was calculated using Weech's formula:

Table 2. Expected weight for age (Weech's Formula)

Age	Expected Weight (kg)
Birth	3
3–12 months	(Age in months + 9) / 2
1–6 years	(Age in years × 2) + 8
7–12 years	[(Age in years × 7) – 5] / 2

5. Waist–Hip Ratio (WHR)

Procedure

Waist circumference was measured at the midpoint between the lower rib and the iliac crest after normal expiration.
Hip circumference was measured at the widest part of the buttocks.
Both were taken using a non-stretchable tape, parallel to the floor.
 $WHR = \text{Waist circumference} / \text{Hip circumference}$

Interpretation

Indicates central obesity and correlates with cardiometabolic risk.
Males: $>0.95 \rightarrow$ High risk
Females: $>0.80 \rightarrow$ High risk

6. Skinfold thickness

Assessed at the triceps site using a calibrated skinfold caliper.

Procedure

The child stood relaxed, and the skinfold was grasped midway between the acromion and olecranon.
The caliper was applied perpendicular to the fold, and readings were taken after 1–2 seconds.
Measurements were taken twice, and the average was recorded in millimetres (mm).

Interpretation

Values were compared with standard age- and sex-specific reference charts to estimate subcutaneous fat.

7. Body Mass Index (BMI)

Formula:



$$MI = \frac{\text{Weight (kg)}}{[\text{Height (m)}]^2}$$

Interpretation was based on WHO and CDC BMI-for-age Z-scores.

Other study variables

Type of Family: Categorized as nuclear (parents and unmarried children) or joint (extended/multi-generation families).

Birth Order: Recorded as stated by the mother.

Exclusive Breastfeeding: Infants fed exclusively with breast milk (excluding medicines and vitamins) until 6 months were classified as solely breastfed.

Adequate Sleep: Children sleeping ≥ 10 hours per night were categorized as “Yes”; those with < 10 hours as “No”.

Physical Activity: As per WHO guidelines, ≥ 60 minutes/day of moderate-to-vigorous physical activity was categorized as “Yes”; < 60 minutes/day as “No”.

Screen Time: Based on American Academy of Paediatrics recommendations, ≤ 2 hours/day was categorized as “No”; > 2 hours/day as “Yes”.

Fast/Junk Food Consumption: Categorized as:

Low consumption: 1–3 days/week

Moderate consumption: 3–5 days/week

High consumption: ≥ 6 days/week

Family History of Obesity: Recorded as “Yes” if any immediate or extended family member (parents, grandparents, siblings, or uncles/aunts) was obese.

Comorbidities

Evaluated for associated conditions such as hypothyroidism, hypertension, diabetes, asthma, reactive airway disease, fatty liver, and dyslipidemia.

Statistical analysis

Data were entered in Microsoft Excel and analyzed using SPSS version 21.0 (IBM Corp., Chicago, USA).

Quantitative variables were summarized as mean $\pm$ standard deviation (SD) or median with interquartile range (IQR).

Categorical variables were expressed as frequency and percentage (%).

Data normality was assessed using the Kolmogorov–Smirnov test. A *p*-value < 0.05 indicated non-normality.

Non-parametric tests were applied where appropriate:

Mann–Whitney U test for continuous variables.

Chi-square test for categorical variables.

Fisher’s Exact test was used when expected cell counts were < 5 .

A Receiver Operating Characteristic (ROC) curve was generated to identify the optimal skinfold thickness cut-off predicting obesity.

Youden Index (Sensitivity + Specificity – 1) was calculated, and the maximum value determined the optimal cut-off.

Sensitivity, specificity, and predictive values were computed at this cut-off point.

A *p*-value < 0.05 was considered statistically significant.

Ethical Considerations

The study received ethical approval from the Institutional Ethics Committee of Malda Medical College and Hospital before data collection. Written informed consent was obtained from the parents or legal guardians of all participating children, and assent was taken from older children wherever appropriate. Confidentiality was maintained by anonymizing all identifiable information, and participation was entirely voluntary. No invasive procedure was performed, and all assessments adhered to standard, non-harmful paediatric examination practices.

Results

Participant flow

A total of 328 children were screened for eligibility during the study period. Of these, 18 children were excluded because they were either critically ill ($n = 7$), had chronic illnesses that interfered with growth assessment ($n = 5$), or parents did not provide consent ($n = 6$). The remaining 310 children were assessed further; however, 10 did not complete all required anthropometric measurements and were excluded from the analysis. Finally, 300 children fulfilled the eligibility criteria and were included in the study and analysed (Figure 1).

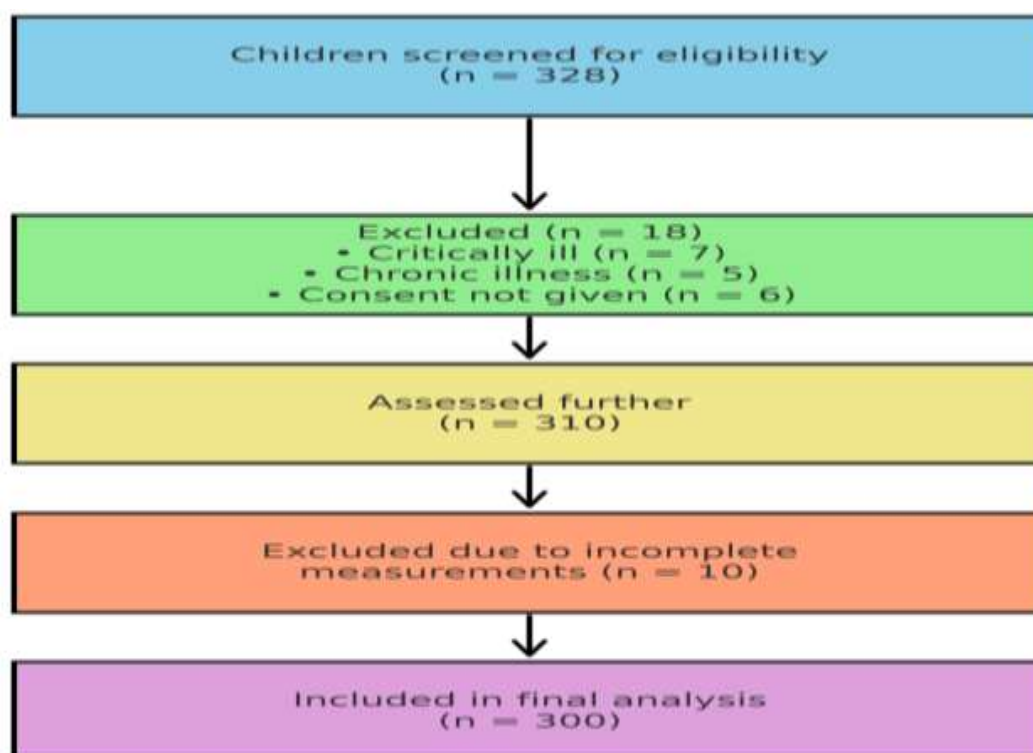


Figure 1: Participant flow diagram

A total of 300 school-going children aged 6–12 years were included in the study. The findings below summarize the sociodemographic characteristics, anthropometric indices, lifestyle patterns, and their association with obesity.

Table 3: Distribution of the study subjects according to their age [n = 300]

Age (Years)	Number (%)	Descriptive statistics [Age in years]
6 – 8	117 (39)	Mean (SD): 9.1 (1.8)
9 – 10	111 (37)	Median (IQR): 9 (8, 10.48)
11 – 12	72 (24)	Range: 6 to 12
Total	300 (100.0)	

Table 4 shows the socioeconomic classification of study subjects according to the Modified BG Prasad Scale (2024).

Socioeconomic Status as per Modified BG Prasad Scale 2024 (based on Per Capita Income)	Number (%)
LOWER (< ₹ 1364)	7 (2.3)
LOWER MIDDLE (₹ 1364 – 2728)	44 (14.7)
MIDDLE (₹ 2729 – 4548)	147 (49)
UPPER MIDDLE (₹ 4549 – 9097)	75 (25)
UPPER (≥ ₹ 9098)	27 (9)
Total	300 (100.0)



Table 5 shows the family type distribution among school-going children.

Type of Family	Number (%)
Nuclear	254 (84.7)
Joint	46 (15.3)
Total	300 (100.0)

Residence distribution

Among the 300 children, 182 (60.7%) were from rural areas, while 118 (39.3%) belonged to urban or semi-urban settings. This reflects the hospital's broad catchment population, comprising mostly rural communities.

Sex distribution

Of the total participants, 156 (52%) were boys, and 144 (48%) were girls. The male-to-female ratio was 1.08:1.

Birth order

Regarding birth order, 112 children (37.3%) were first-born, 134 (44.7%) were second-born, and 54 (18%) were third-born or later.

Table 6: Shows the birth-weight distribution of participants.

Birth Weight (kg)	Number (%)	Descriptive statistics [Birth Weight in kg]
Low Birth Weight (< 2.5 kg)	73 (24.3)	Mean (SD): 2.6 (0.4)
Normal Birth Weight ($\geq$ 2.5 kg)	227 (75.7)	Median (IQR): 2.6 (2.5, 2.9)
Total	300 (100.0)	Range: 1.7 – 4

Table 7: Shows the prevalence of exclusive breastfeeding among the study group.

Exclusive Breastfeeding for 6 months	Number (%)
No	91 (30.3)
Yes	209 (69.7)
Total	300 (100.0)

Table 8: Shows the nutritional status of children according to the WHO BMI-for-Age Z-score.

WHO BMIFA Z-Score Category	Number (%)
Severe Thinness	6 (2)
Thinness	13 (4.3)
Normal	176 (58.7)
Overweight	60 (20)
Obese	45 (15)
Total	300 (100.0)

Table 9: Shows classification based on CDC BMI-for-Age percentiles.

CDC BMIFA Category	Number (%)
Underweight	27 (9)
Normal	177 (59)
Overweight	53 (17.7)
Obese	43 (14.3)
Total	300 (100.0)

Table 10: Shows central-obesity risk assessment using the waist-hip ratio.

Central Obesity Risk using Waist-Hip Ratio	Number (%)	Descriptive statistics [WHR]
Low Risk	201 (67)	Mean (SD): 0.84 (0.07)
High Risk	99 (33)	Median (IQR): 0.84 (0.78, 0.9)
Total	300 (100.0)	Range: 0.71 – 1.01

Table 11: Shows obesity-risk categorization based on triceps skin-fold thickness.

Obesity Risk using Skin-fold Thickness	Number (%)	Descriptive statistics [mm]
Low Risk (< 15.5 mm)	236 (78.7)	Mean (SD): 12.3 (4.9)
High Risk ($\geq$ 15.5 mm)	64 (21.3)	Median (IQR): 11 (9, 15)
Total	300 (100.0)	Range: 6 – 30

Table 12 shows the ROC-based diagnostic accuracy of skin-fold thickness in predicting obesity as per the WHO BMI-for-Age Z-score [n = 300].

Parameters	Value
Area Under Curve / C-statistics (CI)	0.984 (0.971 – 0.997)
Cut-off	15.5 mm
Sensitivity	95.6 %
Specificity	91.8 %
Positive Predictive Value	67.2 %
Negative Predictive Value	99.2 %

Table 13 shows the relationship between physical-activity adequacy and obesity as per the WHO Z-score BMI-for-Age [n = 300].

Adequate Outdoor Physical Activity	Obesity Absent n (%)	Obesity Present n (%)	Total n (%)	χ^2 value	p-Value
No	33 (56.9)	25 (43.1)	58 (100)	$\chi^2 = 42.58$	< 0.001
Yes	222 (91.7)	20 (8.3)	242 (100)		
Total	255 (85.0)	45 (15.0)	300 (100.0)		χ^2 Significant –

Table 14 shows the association between excessive screen time and childhood obesity as per the WHO Z-score BMI-for-Age [n = 300].

Excessive Screen Time > 2 h	Obesity Absent n (%)	Obesity Present n (%)	Total n (%)	χ^2 value	p-Value
No	189 (89.2)	23 (10.8)	212 (100)	$\chi^2 = 9.54$	0.002
Yes	66 (75.0)	22 (25.0)	88 (100)		
Total	255 (85.0)	45 (15.0)	300 (100.0)		χ^2 Significant –

Table 15 shows the prevalence of medical co-morbidities among obese versus non-obese children.

Co-morbidity	Non-obese n = 255 n (%)	Obese n = 45 n (%)	p-Value
Hypothyroid	12 (4.7)	10 (22.2)	< 0.001 *
Diabetes	3 (1.2)	0 (0)	0.613 #
Hypertension	0 (0)	3 (6.7)	0.003 #
Asthma	3 (1.2)	3 (6.7)	0.046 #
Fatty Liver	2 (0.8)	9 (20)	< 0.001 #
Dyslipidemia	0 (0)	4 (8.9)	< 0.001 #

Chi-square test # Fisher Exact test (applied when cell count < 5)*

The analysis of 300 children revealed an obesity prevalence of 15 % (WHO) and 14.3 % (CDC), with 20 % and 17.7 % classified as overweight, respectively. Obesity was significantly higher among boys, those from upper socioeconomic strata, non-breast-fed children, and those with

positive family history. Lifestyle determinants such as frequent fast-food consumption, inadequate physical activity, and screen time > 2 h/day were statistically significant contributors ($p < 0.05$). Common comorbidities linked with



obesity included hypothyroidism, hypertension, asthma, fatty liver, and dyslipidemia, all demonstrating strong significance.

Discussion

The present study aimed to estimate the prevalence of obesity among school-going children aged 6–12 years and to identify associated risk factors, including demographic, socioeconomic, and lifestyle variables. The findings provide a comprehensive overview of the burden of childhood obesity within a tertiary-care setting and reinforce the growing concern of over-nutrition [18].

In this study, the overall prevalence of obesity among school-going children was 15 % according to the WHO BMI-for-Age Z-score and 14.3 % according to the CDC BMI-for-Age chart, while 20 % and 17.7 % were categorized as overweight, respectively. These figures align with national data indicating a consistent upward trend in paediatric obesity prevalence across India and parallel the global observation that childhood obesity has risen dramatically in recent decades [3,4,14]. The worldwide prevalence of obesity among children aged 5–19 years has reportedly increased from 4 % in 1975 to over 16 % in 2016 [14], validating the ongoing shift described previously.

The gender distribution revealed a significantly higher prevalence of obesity among male children (19.9 %) compared with females (10.4 %) ($p = 0.022$). This finding is consistent with the biological and behavioural differences between sexes, where boys often engage in more sedentary screen-based activities and exhibit higher caloric intake, while girls may experience societal pressures to remain lean [19].

When stratified by age group, obesity prevalence increased progressively from 9.4 % (6–8 years) to 18 % (9–10 years) and 19.8 % (11–12 years), demonstrating a significant positive correlation ($p = 0.020$). This suggests that the cumulative impact of prolonged exposure to an obesogenic environment characterized by declining physical activity and increased processed-food consumption intensifies with age, reaffirming trends mentioned earlier [7,8,9,15].

A strong and statistically significant association was observed between socioeconomic status and obesity, with the highest prevalence recorded among children from upper and upper-middle classes ($p < 0.05$). This relationship underscores the role of rapid urbanization and improved income levels, leading to greater accessibility of calorie-dense, nutrient-poor foods, as discussed previously [5,7,8]. Conversely, family type did not show a significant relationship, suggesting that urban dietary and lifestyle patterns transcend nuclear or joint-family structures.

The study demonstrated that children who were not exclusively breast-fed for six months had a markedly higher prevalence of obesity (25.3 %) compared with those who were breast-fed (10.5 %), confirming a protective role of exclusive

breastfeeding ($p = 0.001$). Breast milk contains key hormones such as leptin and adiponectin that help regulate energy balance and fat deposition, supporting the metabolic rationale cited earlier [11].

Birth weight did not exhibit a significant association with obesity in this cohort, indicating that environmental and lifestyle determinants exert greater influence during later childhood than perinatal parameters. Similarly, birth order showed no statistically meaningful relationship, even though first-born children demonstrated a slightly higher prevalence (21.4 %). These observations suggest that modifiable lifestyle factors play a more critical role than the biological sequence of birth in determining long-term adiposity [20].

A positive family history of obesity emerged as a statistically significant risk factor ($p < 0.001$). Among obese children, 31 % reported an obese parent or close relative, confirming the combined influence of genetic predisposition and shared household behaviours such as dietary practices and reduced physical activity [21].

Nutritional behaviour strongly influenced outcomes. Children with high fast-food or junk-food consumption (≥ 6 days/week) had a 30.3 % obesity rate compared with only 4.2 % among low-consumption groups ($p < 0.001$). This highlights the role of processed, high-fat, high-sugar foods in promoting energy imbalance and weight gain, consistent with the environmental triggers detailed in the Introduction [8,16].

Although inadequate sleep was reported by only 6 % of participants, no significant correlation with obesity was observed. Nonetheless, shorter sleep duration is widely recognized as a contributor to hormonal dysregulation of appetite and metabolic slowdown, warranting further exploration [22].

Physical inactivity demonstrated a pronounced association with obesity: 43.1 % of children lacking at least one hour of outdoor activity per day were obese, compared with only 8.3 % among active peers ($p < 0.001$). This finding directly supports WHO recommendations for at least 60 minutes of moderate-to-vigorous physical activity daily for children, reaffirming its preventive importance [17].

Likewise, excessive screen time (> 2 hours/day) was significantly correlated with obesity ($p = 0.002$). Children exceeding the recommended duration had a 25 % obesity rate, compared with 10.8 % among those within limits. This relationship reinforces the earlier observation that prolonged screen exposure reduces physical activity, alters sleep–wake cycles, and increases snacking tendencies [9].

Skin-fold thickness proved a reliable clinical indicator, with a sensitivity of 95.6 %, specificity of 91.8 %, positive predictive value of 67.2 %, and negative predictive value of 99.2 % at a 15.5 mm cut-off. This highlights its usefulness as a simple, non-invasive screening measure for paediatric obesity in resource-limited settings.

The assessment of co-morbidities revealed significantly higher prevalence of hypothyroidism (22.2 %), fatty liver (20

%), dyslipidaemia (8.9 %), and hypertension (6.7 %) among obese children compared with their non-obese counterparts ($p < 0.05$). These findings confirm that metabolic complications begin early in life and substantiate the concept of obesity as a systemic disorder rather than a purely cosmetic issue [23].

Overall, this study underscores that childhood obesity is a multifactorial condition driven by the interplay of behavioural, socioeconomic, and environmental influences, rather than genetic factors alone. Preventive measures should focus on encouraging exclusive breastfeeding, promoting balanced nutrition, reducing screen exposure, and ensuring adequate physical activity. Early lifestyle modifications during school age are critical to preventing the transition of childhood obesity into adult metabolic disease [24].

Therefore, consistent with the observations presented in the Introduction, the current analysis confirms that rising urban affluence, sedentary behaviours, and dietary westernization remain the key drivers of the childhood obesity epidemic in India. Implementation of school-based awareness programs, parental education, and community-level interventions is essential to curb this growing public-health threat.

Generalizability

The generalizability of these findings should be interpreted in light of the study setting. The data were derived from school-going children attending a tertiary-care hospital in Malda, which receives referrals from both rural and semi-urban areas of northern West Bengal. This diverse catchment improves external validity by capturing children from varied socioeconomic and lifestyle backgrounds. However, because the sample was hospital-based rather than drawn from community or school clusters, the results may not fully represent all children in the region, particularly those with limited access to healthcare facilities. Nevertheless, the observed patterns in obesity prevalence and associated lifestyle determinants are consistent with trends reported in similar Indian and South Asian populations, suggesting that the findings hold reasonable applicability to comparable settings.

Conclusion

Childhood obesity has emerged as one of the most prevalent nutritional disorders worldwide, driven by technological advancement, sedentary lifestyles, and poor dietary habits. The present study highlights a significant prevalence of obesity among school-going children, identifying physical inactivity, excessive screen time, high fast-food consumption, and socioeconomic affluence as key contributors. Given the early onset of related metabolic complications, prompt identification and preventive interventions are critical. Integrating school-based health education, parental guidance,

and community awareness programmes can substantially mitigate the growing burden of childhood obesity. Long-term cohort studies are warranted to understand its progression into adulthood and to refine targeted public-health strategies.

Limitations

The present 12-month hospital-based cross-sectional study provides valuable insight into the burden and determinants of childhood obesity; however, it is not without limitations. The restricted study duration may not adequately capture long-term or seasonal variations influencing obesity prevalence. Since the study population was limited to children attending a tertiary-care hospital, the findings may not fully represent the general paediatric population. The cross-sectional design also limits causal inference between obesity and associated risk factors. Moreover, information on dietary habits, sleep duration, and physical activity was self-reported, introducing possible recall and reporting bias. Genetic predisposition could not be comprehensively analysed owing to the absence of molecular or advanced genetic assessments, and some potential confounders, including psychological stress and environmental factors, might not have been completely accounted for.

Recommendations

Regular school- and community-based screening programmes are essential for early identification of children at risk for obesity and for initiating timely lifestyle interventions. Collaborative efforts among healthcare professionals, educators, and parents are crucial to promote balanced nutrition, adequate physical activity, and healthy behavioural practices. Educational institutions should include structured physical activity within daily curricula and promote outdoor recreation consistent with WHO recommendations. Parental awareness and guidance are vital for maintaining a healthy home environment, limiting screen time, and discouraging high-calorie food intake. Furthermore, public health authorities must strengthen policies regulating the marketing and availability of calorie-dense processed foods. Future multicentric longitudinal studies are recommended to establish causal pathways and explore regional variations in childhood obesity trends more comprehensively.

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Abbreviations

BMI: Body Mass Index

WHO: World Health Organization

CDC: Centers for Disease Control and Prevention

OPD: Outpatient Department

SD: Standard Deviation

SPSS: Statistical Package for the Social Sciences

CI: Confidence Interval

IQR: Interquartile Range

ROC: Receiver Operating Characteristic

AUC: Area Under the Curve

CPI-IW: Consumer Price Index for Industrial Workers

NCDs: Non-Communicable Diseases

MM: Millimetre

Kg: Kilogram

Cm: Centimetre

Source of funding

The study had no funding.

Conflict of interest

The authors declare no conflict of interest.

Author contributions

SP-Concept and design of the study, results interpretation, review of literature and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript. GB-Concept and design of the study, results interpretation, review of literature and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript. MKA-Concept and design of the study, results interpretation, review of literature and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript. SS-Concept and design of the study, results interpretation, review of literature and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript.

Data availability

Data available on request

Author biographies

Dr. Salma Pervin, Post Graduate Trainee, Department of Paediatrics, Malda Medical College, Malda, West Bengal, India. Her academic interests include paediatric infectious diseases and neonatal health. ORCID ID: <https://orcid.org/0009-0004-0946-7405>

Dr. Gauranga Biswas, Associate Professor, Department of Paediatrics, Malda Medical College, Malda, West Bengal, India. He has extensive teaching and research experience in paediatric medicine with a focus on childhood nutrition and growth disorders. ORCID ID: <https://orcid.org/0009-0008-7449-1160>

Dr. Muazzem Kamal Afrose, Post Graduate Trainee, Department of Paediatrics, Malda Medical College, Malda, West Bengal, India. His research interests include neonatal intensive care and paediatric endocrinology. ORCID ID: <https://orcid.org/0009-0008-0971-7792>

Dr. Sushama Sahoo, Associate Professor and Head, Department of Paediatrics, Malda Medical College, Malda, West Bengal, India. She has over two decades of clinical and academic experience in paediatric medicine, with special emphasis on community and preventive paediatrics. District – Malda. ORCID ID: <https://orcid.org/0000-0002-6216-8189>

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