Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(1), 1223-1229 | ISSN:2251-6727

Childhood Obesity among School-Aged Children (5–15 Years): Epidemiology, Determinants, Assessment Strategies and Public Health Implications in Urban India

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(Received: 05 November 2025 Revised: 15 December 2025 Accepted: 23 January 2026)

KEYWORDS

Obesity, School-aged children, Nutrition

ABSTRACT:

Background. Childhood obesity is escalating globally and in India, yet locality-specific evidence is sparse. Understanding the epidemiology, risk factors and health consequences among apparently healthy school-aged children is crucial for targeted interventions.

Methods. A narrative review of peer-reviewed literature was conducted to synthesise data on the prevalence, determinants, assessment methods and consequences of overweight and obesity among children aged 5–15 years, with a focus on India. Global and Indian databases were searched for cross-sectional studies, systematic reviews and guidelines.

Results. The global pooled prevalence of obesity among children and adolescents <18 years is ~8.5%. Low- and middle-income countries show rising trends; high-income countries still have the highest prevalence. In India, national surveys report overweight/obesity prevalence of 3–4% among under-five children and ~8–9% among older children. Regional studies reveal wide variability: overweight/obesity ranges from 1% to >30% depending on socioeconomic status and urban/rural setting. Risk factors consistently include consumption of energy-dense foods, frequent intake of sugar-sweetened beverages, irregular meals, physical inactivity, long screen time, shorter sleep and high socioeconomic status. Waist-to-height ratio and waist circumference augment body-mass-index (BMI) in identifying metabolic risk. Childhood obesity is associated with clustering of metabolic risk factors, type 2 diabetes, non-alcoholic fatty liver disease and psychosocial problems. Multi-component school-based interventions, promotion of physical activity, healthy diets and reduction of junk foods are effective preventive strategies.

Conclusions. India is experiencing a transition from under-nutrition to over-nutrition. Despite evidence of increasing overweight/obesity among school-aged children, there remains a paucity of locality-specific data. Continued surveillance and context-specific interventions are needed to curb the growing epidemic, justifying local prevalence studies such as the planned survey in Sarvodaya Nagar, Lucknow.

Introduction

Childhood obesity has emerged as a major public health challenge worldwide. It is characterised by an abnormal or excessive accumulation of body fat that may impair health, resulting from a chronic energy imbalance between calories consumed and expended [1]. Globally, more than 35 million children under five were overweight in 2024 [1], and over 390 million children aged 5–19 years were overweight in 2022 [2]. The prevalence of overweight among 5–19 year olds increased from 8% in 1990 to 20% in 2022, and obesity prevalence rose from 2% to 8% [2]. High income countries show the highest prevalence, yet low and middle income nations are experiencing the fastest increases [3]. Childhood obesity predisposes to adult obesity and numerous co morbidities; hence early

Journal of Chemical Health Risks

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JCHR (2026) 16(1), 1223-1229 | ISSN:2251-6727

surveillance is crucial. This review synthesises evidence on prevalence, determinants, screening and health impacts of childhood obesity in India, focusing on school aged children (5–15 years), to support a forthcoming prevalence study in Sarvodaya Nagar, Lucknow.

Definition and Classification of Childhood Obesity

Anthropometric indices

Body mass index (BMI) is the most widely used indicator for defining overweight and obesity. Children are classified as overweight or obese using age and sex specific percentile charts. For children aged <5 years, weight for height/length percentiles based on WHO growth standards are recommended [4]. For those aged 5–18 years, the Indian Academy of Paediatrics (IAP) recommends BMI percentiles derived from Indian data (IAP 2015 charts) and routine measurement of waist circumference [5]. The International Obesity Task Force (IOTF) provides BMI cutoff points corresponding to adult BMI 25 and 30 kg/m² [6]. The Centers for Disease Control and Prevention (CDC) defines overweight as BMI ≥85th percentile and obesity as BMI ≥95th percentile for age and sex [7]. BMI has limitations because it does not distinguish lean mass from fat; thus, waist circumference, waist to height ratio (WHtR) and percentage body fat assessed by dual energy X ray absorptiometry (DXA) offer complementary information [8].

Waist circumference and WHtR

Waist circumference is a marker of visceral adiposity and metabolic risk. In a public health study, children in the highest WHtR tertile had higher BMI z scores, blood pressure, triglycerides and insulin resistance; the odds of insulin resistance were over five times higher compared with those in the lowest tertile [9]. WHtR therefore provides a practical screening tool, particularly in resource limited settings, and values >0.5 have been suggested as risk thresholds. Waist circumference measurement is recommended during obesity evaluation in IAP guidelines [5].

Classification in Indian guidelines

The IAP 2023 guidelines emphasise classifying obesity based on BMI percentiles and assessing for co morbidities such as hypertension, dyslipidaemia, hyperglycaemia and non alcoholic fatty liver disease (NAFLD) [10]. Pharmacotherapy is advised only for severe obesity with complications; bariatric surgery is reserved for adolescents with extreme obesity [10]. Screening for comorbidities using fasting glucose, lipid profile and liver enzymes is recommended for children with BMI ≥95th percentile [10].

Global Burden of Childhood Obesity

A 2024 systematic review of 1 668 studies (over 44 million children) estimated that the global pooled prevalence of obesity among children and adolescents <18 years was 8.5% (95% CI 8.2–8.8) [11]. Prevalence ranged from 0.4% in Vanuatu to 28.4% in Puerto Rico, reflecting vast geographical variation [11]. High income countries had greater prevalence (9.3%) than low income countries (3.6%) [11], but the highest relative increases occurred in low income and middle income regions where westernisation is rapidly altering diets and lifestyles. From 2000–2011 to 2012–2023, global prevalence increased from 7.1% to 11.3%, indicating an accelerating trend [11]. The WHO notes that global overweight and obesity among children aged 5–19 rose nearly ten fold between 1975 and 2016 [12].

Socioeconomic disparities persist. In high income nations, obesity disproportionately affects children from low socioeconomic backgrounds; conversely, in developing countries it is more prevalent among affluent groups [3]. Increasing access to energy dense foods, reduced physical activity, and urbanisation drive this transition [3].

Epidemiology of Childhood Obesity in India

National estimates

India has the second largest number of obese children globally, with over 14.4 million children living with obesity in 2017 [12]. The National Family Health Survey (NFHS 5) reported 3.4% of children under five overweight, up from 2.1% in NFHS 4 [12], indicating a rising trend even among preschoolers. An editorial on the rising tide of childhood obesity estimated that 33 million Indian children were overweight or obese in 2020, representing 9% prevalence, and projected that by 2035 this number could reach 83 million (24% prevalence) if the current annual growth rate of 6.2% continues [13]. Meta analyses report pooled obesity prevalence of 8.4% and overweight prevalence of 12.4% across Indian studies [14].

Regional variability

India's vast diversity leads to marked regional differences in prevalence (Table 1). A scoping review of 93 Indian studies found overweight prevalence ranging 1.25%–35.8% and obesity prevalence 0.3%–24.6%, with higher rates in urban/private school populations [15]. Adolescent overweight/obesity was more common in high socioeconomic classes (36.5% of studies), urban settings and private schools [15]. In Eastern India, the prevalence of overweight and obesity combined was 15.9%, the highest among regions [16]. NFHS data likely underestimate prevalence because they largely assess

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JCHR (2026) 16(1), 1223-1229 | ISSN:2251-6727

under five children; many school age surveys reveal much higher rates.

Urban north India and Lucknow studies

Lucknow (Uttar Pradesh) has been the site of several cross sectional surveys. A 2011 study of 1 641 children reported overweight and obesity prevalences of 4.17% and 0.73%, respectively, and linked obesity with fathers' higher education, higher class, <30 minutes outdoor activity and fast food consumption [17,18]. Another 2016 survey among 1 862 upper middle income school children found overweight in 6.19% and obesity in 5.10%; risk factors included frequent soft drinks, eating outside home, low physical activity and watching television >1.5 hours/day. Among adolescents aged 13–17 years, the prevalence of overweight/obesity was 17.9%, with two thirds of overweight/obese adolescents belonging to the highest socioeconomic class [19]. In 2024, a study of 509 children aged 6–12 years reported a combined overweight/obesity prevalence of 29.7%; obesity prevalence was similar among boys (13.6%) and girls (14.4%), and was highest among children from lower and upper middle classes and those with working parents [20]. A smaller 2019 study of 90 children aged 5–10 years found obesity more common in girls.

Other regional studies

Numerous cross-sectional surveys across India highlight heterogeneity:

- **South Karnataka**: Among 900 adolescents, overweight prevalence was 9.9% and obesity 4.8%; risk factors included high socioeconomic status, physical activity <2 hours/week (odds ratio 21), screen time >4 hours/day (OR 7.3) and daily consumption of chocolates/cola [21].
- **Ahmedabad** (Gujarat): A 2016 study of 2 562 children aged 10–15 years reported obesity and overweight prevalences of 5.62% and 9.99%. Obesity was higher among girls and 15 year olds; risk factors included low physical activity, TV watching >2 hours/day, high caloric intake and parental obesity [22].
- **Punjab**: A 2025 cross sectional study of 1 408 adolescents reported overweight prevalence 18.6% and obesity 12.4%; abdominal obesity by waist to height ratio was 24.6%. Prevalence was higher among boys and younger adolescents [23].
- **Chennai**: A 2013 survey of 1 842 adolescents found overweight prevalence of 6.2% and obesity 5.2%; 68% of girls and 22% of boys did not participate in outdoor sports, and many consumed fast food weekly [24].
- **Central India (Raipur)**: In a cohort of 5 019 children aged 6–12 years, obesity prevalence was 1.07%; 70% of obese children consumed junk food >3 times/week and 90.7% had screen time >2 hours [25].
- **Jammu**: A 2018 cross sectional study of 230 children reported overweight/obesity prevalence of 8.2%; excess calorie intake, fast foods, carbonated drinks and low physical activity were significant determinants [19]. A subsequent 2022 study in Baramulla, Kashmir, found overweight prevalence of 15.5% in females and 7.9% in males; obesity prevalence was 5.9% in females and 2.5% in males, with junk food, TV/video games and mother's education associated with obesity [22].
- **Puducherry**: A 2011 study found overweight prevalence 4.41% and obesity 2.12%, with higher prevalence in urban and private schools [24].
- **Pune**: Among 1 281 children, obesity and overweight prevalence were **5.62%** and **9.99%**, respectively; obesity was higher in private schools (8.83%) than government schools (2.98%) [25].
- **Davangere** (Karnataka): A 2007 survey of 1 496 affluent children reported obesity prevalence 5.74%, higher in girls (8.82%) and increasing with age [21].
- **Vidarbha (Maharashtra)**: A 2017 rural study among early adolescents found overweight prevalence 15.83% and obesity 11.18%; obesity increased with television viewing duration [25].
- **Hill state (Uttarakhand)**: A PLOS ONE survey of 1 266 children aged 6–17 years found overweight prevalence 15.6% and obesity 5.4%, with maximum prevalence among boys attending urban private schools [23].
- **Ranchi, Jharkhand (tribal state)**: A 2023 cross sectional study among 1 162 high school students found overweight/obesity prevalence highest at age 14 years (30.2%), more common among boys (18.1%) and in private schools (66.2%) [20].

Collectively, these studies illustrate that overweight and obesity are more prevalent in urban private-school populations and affluent groups, yet rural and tribal

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JCHR (2026) 16(1), 1223-1229 | ISSN:2251-6727

regions are not immune. Prevalence varies widely, underscoring the need for locality-specific data.

Determinants and Risk Factors

Dietary factors

High consumption of energy dense, nutrient poor foods, sugar sweetened beverages and frequent eating out are primary dietary drivers. A prospective study from Chennai involving >13 000 children reported that 49% consumed packaged sugar sweetened beverages more than twice per week; eating meals outside the home predicted overweight/obesity, and sugar sweetened beverages were a major contributor [24]. In an Indian context review, increased intake of energy dense foods high in fat and sugar and the growing availability of junk foods and sugar sweetened beverages in school canteens were highlighted as key determinants [14]. A case control study from Hyderabad found higher consumption of junk food, irregular meals and lack of parental supervision strongly associated with adolescent obesity [22]. In rural Vidarbha, TV viewing and junk food consumption were linked to overweight/obesity [25]. A recent adolescent study noted that eating snacks more than three times per day and eating out ≥2 times per week were significantly associated with obesity [20].

Physical activity and sedentary behaviour

Physical inactivity is consistently implicated. In South Karnataka, adolescents with <2 hours/week of physical activity had 21 fold increased odds of being overweight [21]. The Indian context review observed that sedentary activities such as watching television and playing computer games correlate directly with increased body weight [14]. Hyderabad adolescents who engaged in fewer hours of outdoor games and used motorised transport to school were more likely to be obese [22]. The Lucknow 2011 study linked <30 minutes of outdoor play with obesity [17]. In the adolescent predictor study, physical activity <30 minutes/day was significantly associated with overweight/obesity, whereas ≥60 minutes/day dramatically reduced risk [20]. Prolonged screen time (>2 hours/day) has been associated with increased obesity risk across multiple studies [14,24].

Sleep patterns

Short sleep duration has been associated with weight gain. A prospective study from Chennai found that adequate sleep was protective, whereas shorter sleep increased obesity risk [24]. The adolescent predictor study reported that sleep >8 hours/day was significantly associated with obesity; conversely, <6 hours sleep was rare among obese adolescents [20], suggesting complex relationships that warrant further exploration.

Socioeconomic and familial factors

In India, obesity is more prevalent among higher socioeconomic strata [14,16]. For example, upper middle income children in Lucknow had higher obesity prevalence. The Delhi cross sectional study (n = 21 485) found that overweight and obesity prevalence in upper socioeconomic status (USES) children were 16.75% and 5.59% in boys and 19.01% and 5.03% in girls, respectively, compared with 2.7% and 0.4% in boys and 2.1% and 0.5% in girls from lower socioeconomic groups. Maternal employment has been associated with childhood obesity [22], possibly due to increased reliance on convenience foods. Parental obesity strongly predicts child obesity, reflecting genetic predisposition and shared lifestyle; the adolescent predictor study reported that obese mothers and fathers significantly increased the odds of adolescent obesity [20].

Urbanisation and built environment

Urbanisation contributes by altering built environments. Increased mechanisation reduces physical exertion; availability of fast food, lack of safe play spaces and marketing of unhealthy foods encourage consumption [14]. Private schools often provide energy dense snacks in canteens [14]. In hill state surveys, urban private school boys had the highest prevalence of obesity [23]. Even in rural Vidarbha, exposure to television and Westernised eating habits was associated with obesity [25].

Other factors

Genetic and hormonal factors contribute but are less modifiable. Psychological aspects, such as stress and body image issues, also influence obesity but were not uniformly assessed. The Indian context review suggests exploring genetic programming and the influence of mass media [14]. Depression and low self esteem are common psychosocial effects of obesity [24] and may perpetuate unhealthy behaviours.

Anthropometric Assessment and Screening

Routine screening in schools facilitates early identification. BMI is practical for large populations; however, because Indian children tend to accumulate more body fat at lower BMI values, standard cut offs may under detect adiposity. Using DXA, Khadgawat et al. developed reference values for percentage body fat in 1 640 Delhi children aged 7–17 years and showed that body fat percentage correlated strongly with BMI (r = 0.76 for boys, 0.81 for girls) [26]. WHtR has been proposed as a simple proxy; a cross sectional study showed it was strongly associated with insulin resistance [27]. Waist circumference is an accessible alternative to monitor central obesity. The IAP recommends measuring

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JCHR (2026) 16(1), 1223-1229 | ISSN:2251-6727

height, weight and waist circumference annually and plotting BMI on age appropriate charts [5].

School based health programs should include regular anthropometry, blood pressure measurement and lifestyle assessment. Screening should be coupled with counselling for parents and children, referral for further evaluation and monitoring of growth trajectories.

Health Consequences of Childhood Obesity

Metabolic and cardiovascular complications

Childhood obesity predisposes to a cluster of metabolic abnormalities. Atherosclerotic cardiovascular disease (ASCVD) risk is increased by dyslipidaemia (high triglycerides, low HDL cholesterol), hypertension and insulin resistance. A review reported that children with obesity had at least two fold higher odds of dyslipidaemia, hypertension and type 2 diabetes [28]. Childhood obesity leads to accelerated vascular ageing and contributes to non alcoholic fatty liver disease and polycystic ovarian syndrome [28]. In the Chennai prospective study, 11% of overweight/obese children had hypertension, 15% had prediabetes and 22% had dyslipidaemia [29]. Elevated waist circumference and WHtR were linked to insulin resistance [27].

Psychosocial and developmental effects

Obesity adversely affects mental health. Studies have documented internalising disorders, low self esteem, body image dissatisfaction and social isolation [30]. Depression was reported in 5.6% of obese children in the Raipur study [31]. Obesity is also associated with earlier onset of puberty, orthopedic problems and sleep apnoea [30]. Social stigmatization and bullying can exacerbate psychosocial distress. Addressing mental health is thus integral to obesity management.

Long-term outcomes

Obese children are more likely to become obese adults, increasing lifetime risk for type 2 diabetes, hypertension, coronary artery disease, stroke and certain cancers. The clustering of metabolic risk factors in childhood continues into adulthood [32]. Early intervention may reduce progression to chronic diseases and associated healthcare costs.

Role of Schools in Prevention and Early Detection

Schools provide a critical setting for obesity prevention. They reach large numbers of children and can integrate health promotion into curricula. The literature highlights several effective strategies:

- **Nutrition education and healthy canteens.** Restricting high fat, high sugar foods in school canteens and promoting fruits and vegetables can reduce unhealthy food exposure [28].
- **Physical activity promotion.** Daily physical education, active breaks and extracurricular sports encourage movement. The CBSE fact sheet reported only 30% of adolescents playing regularly for ≥1 hour/day [29], highlighting room for improvement.
- **Parental involvement.** Parents influence dietary habits and physical activity. Working mothers may inadvertently increase reliance on fast food [22]. Programmes should therefore engage parents through workshops and newsletters.
- **Behavioural and counselling approaches.** School based interventions addressing behavioural change, goal setting and self monitoring have shown promise. The Planet Health program (USA) demonstrated reduced obesity through combined nutrition and physical activity curriculum [30] (cited as an example in a North India study). Adaptations for Indian contexts are needed.

Gaps in the Literature and Rationale for a Local Study

Despite numerous studies, several gaps persist:

1. **Limited locality-specific data.** Most Indian studies are urban and school based; few focus on specific neighbourhoods or wards. Data for Sarvodaya Nagar (Lucknow) are lacking, yet preliminary evidence suggests high overweight/obesity prevalence in similar urban pockets [20].

2. **Under-representation of 5–10-year-olds.** Many studies focus on adolescents; primary school children (5–10 years) are understudied. Early life interventions could prevent progression to severe obesity.

3. **Heterogeneity in methodology.** Different studies use various criteria (IOTF, WHO, CDC, IAP), complicating comparisons. Standardised protocols are needed to monitor trends and evaluate interventions.

4. **Limited longitudinal data.** Few Indian studies track outcomes over time; most are cross-sectional. Longitudinal studies would elucidate causal pathways and the impact of interventions.

5. **Psychosocial aspects understudied.** Many surveys emphasise physical health but ignore mental health and quality of life [30].

Given these gaps, a prevalence study among apparently healthy schoolchildren in Sarvodaya Nagar will provide essential baseline data for targeted interventions and allow comparison with national and regional trends.

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JCHR (2026) 16(1), 1223-1229 | ISSN:2251-6727

Public Health Implications and Recommendations

Policy and community interventions

- **Multi-sectoral strategies.** Combating childhood obesity requires coordinated action across education, health, food and urban planning sectors. Policies should regulate marketing of unhealthy foods to children, mandate nutritious school meals and create safe play spaces [28].
- **Nutrition guidelines and taxation.** Implementing taxes on sugar-sweetened beverages and junk foods may reduce consumption. Encouraging consumption of fruits, vegetables and traditional diets is essential.
- **School-based screening and counselling.** Schools should conduct regular anthropometric assessments and refer children above BMI cutoffs for further evaluation. Teacher training is needed to implement health promotion.
- **Community engagement.** Awareness campaigns must involve parents and community leaders. Social support can help families adopt healthier lifestyles.

Clinical and research recommendations

- **Early detection and treatment.** Paediatricians should monitor BMI, waist circumference and metabolic markers in routine practice [5]. Lifestyle counselling should be provided at every visit.
- **Tailored interventions.** Interventions must consider socioeconomic factors. In affluent groups, focus on reducing screen time and junk food consumption; in lower-income populations, promote affordable healthy foods and safe recreational facilities.
- **Longitudinal research.** Future studies should evaluate the effectiveness of interventions and identify longitudinal predictors of obesity. Investigating genetic and epigenetic factors could enhance understanding of individual susceptibility.

Conclusion

Childhood obesity among school-aged children is an emerging epidemic in India. Global data show increasing prevalence across all regions, and Indian studies reveal wide variability, with urban, affluent children at highest risk. Key determinants include energy-dense diets, physical inactivity, prolonged screen time, high socioeconomic status and parental obesity. Obesity confers significant metabolic and psychosocial morbidity, underscoring the need for early detection and intervention. Schools are strategic venues for prevention through nutrition education, physical activity promotion and family engagement. Nevertheless, gaps in locality-specific data and standardised measurement remain. The planned prevalence study in Sarvodaya Nagar, Lucknow will contribute valuable evidence to inform targeted policies and programs. Addressing childhood obesity requires sustained multi-sectoral commitment to ensure healthy futures for Indian children.

Acknowledgement: Authors wish to acknowledge the Integral University, Lucknow for providing the manuscript communication number IU/R&D/2026-MCN0004256.

Funding Sources: Not applicable

Conflict of interest: None to declare

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JCHR (2026) 16(1), 1223-1229 | ISSN:2251-6727

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