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Meta-Analysis

Childhood overweight and obesity in India (2015–2025): a systematic review and meta-analysis of epidemiology and socioeconomic correlates

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ABSTRACT

Childhood overweight and obesity are emerging public health challenges in India, driven by rapid urbanization, dietary transitions, and lifestyle changes. This systematic review and meta-analysis synthesized evidence published between 2015 and 2025 to estimate the prevalence of overweight and obesity among Indian children and adolescents and examine associated socioeconomic and lifestyle factors. Following PRISMA guidelines and PROSPERO registration (CRD420251165983), a comprehensive search identified 47 eligible studies comprising 54,915 participants. Using random-effects meta-analysis, the pooled prevalence of obesity was 5.01% (95% CI: 4.25–5.83; I^2=94.47%), while overweight prevalence was 11.64% (95% CI: 9.83–13.57; I^2=97.85%), indicating substantial heterogeneity across studies. Gender-stratified analyses revealed a slightly higher burden among boys than girls for both obesity (5.21% versus 4.58%) and overweight (11.02% versus 10.73%). Geographical analyses demonstrated higher prevalence in Eastern and Southern India compared with Northern and Western regions. Narrative synthesis consistently identified higher socioeconomic status, urban residence, private schooling, reduced physical activity, sedentary behaviour, unhealthy dietary practices, and increased screen time as important correlates of excess weight. Despite considerable heterogeneity, publication bias was not detected. These findings suggest that approximately one in nine Indian children are overweight and one in twenty is obese, representing a substantial and growing public health burden. The observed demographic, geographic, and socioeconomic disparities highlight the need for standardized surveillance systems, context-specific prevention strategies, and early interventions targeting modifiable lifestyle risk factors to prevent the rising epidemic of childhood obesity in India.

Keywords: Obesity, Overweight, Childhood, Prevalence, India, Meta-analysis

INTRODUCTION

Childhood obesity has emerged as a pressing global health concern with constantly increasing prevalence and critical health consequences for both the individual and the health system. In 2022, more than 390 million children aged 5-19 years were classified as overweight, including approximately 160 million living with obesity.[1] This rise is not limited to high-income nations but is increasingly observed in low-income countries, driven by rapid socioeconomic and lifestyle factors. Between 1990 and 2021, the Asian region saw the most significant rise in pediatric overweight and obesity, specifically in Southeast and East Asia, and these sub-regions are expected to continue to experience the most rapid growth in numbers through 2050, substantially increasing pressure on global health systems.[2]

Overweight and obesity among children in India shows a clear ascending trend. National household data show that the prevalence of overweight among under-fives increased from approximately 2.1% to 3.4% between earlier National Family Health Survey (NHFS) rounds and NFHS-5 (2019-2021).[3] Among school-age children and adolescents, the Comprehensive National Nutrition Survey (CNNS) (2016-18) reported that 4 % of children aged 5–9

years and 5% of those aged 10–19 years were overweight, while obesity prevalence was 1% in both groups nationally.[4,5] A systematic review from Asian countries estimated that among adolescents aged 12–19 years, overweight and obesity prevalence were 13.7% and 6.2% in girls and 15.9% and 10.1% in boys, respectively.[6] A trend analysis by NCD-RisC found that youth obesity is rising globally, a trajectory India has begun to mirror.[1,7] It is projected that by 2030, 27 million Indian children aged 5–19 years will be living with obesity, accounting for 11% of the global burden.[4,8] This burden is more concentrated in urban areas with higher-income groups, as the double burden trend is propelled mainly by rising obesity rather than changes in underweight.[3-5,9,10]

The driving factors of childhood overweight and obesity are sustained energy imbalance, increased consumption and availability of processed foods, changing dietary patterns, increased screen time, declining physical activity, and rapid urbanization.[11] Diets have increasingly shifted towards energy-dense, nutrient-deficient food, which is widely available and heavily marketed.[12] Obese children and adolescents are almost five times more likely to remain obese in maturity compared to their non-obese counterparts.[13,14] Psychosocial consequences include low self-esteem, poor school performance, and increased vulnerability to depression, anxiety, and behavioural disorders.[15] Metabolic effects include insulin resistance, earlier onset of type-2 diabetes, hypertension, atherogenic dyslipidemia, and cardiometabolic diseases.[16] Pediatric liver disease is increasingly common, affecting about 13% of children overall and 47% of those with obesity, and is associated with elevated cardiovascular risk.[17,18]

India has several single-site observational studies on childhood overweight and obesity; however, the evidence remains scattered and inconsistent. Differences in age bands, school-only sampling, and study design make it difficult to compare trends. Previous systematic reviews have synthesized parts of this literature, however, neither focused specifically on this decade 2015-2025, which encompasses the most recent phase of nutritional and lifestyle transition in India. The present systematic review was therefore undertaken to provide an updated, methodologically rigorous synthesis restricted to this contemporary decade.

This systematic review and meta-analysis aims to: map the pooled prevalence of overweight and obesity among Indian children and adolescents aged 5–19 years over the decade 2015–2025; explore subgroup variations by gender, geography and diagnostic criteria; and identify key socioeconomic and lifestyle factors associated with childhood overweight and obesity in India.

METHODS

This systematic review and meta-analysis was conducted in accordance with the preferred reporting items for systematic reviews and meta-analyses (PRISMA 2020) guidelines. The review protocol was prospectively registered in the international prospective register of systematic reviews (PROSPERO) [registration ID: CRD420251165983].

Search strategy

A comprehensive and systematic literature search was conducted across four electronic databases: PubMed, Google Scholar, ScienceDirect, and Ovid MEDLINE from January 2015 to June 2025. The search strategy combined both keywords and Medical Subject Headings (MeSH) using Boolean operators. The core search string included: ("child" OR "adolescent" OR "children" OR "paediatric" OR "pediatric" OR "youth" OR "school-age") AND ("obesity" OR "overweight" OR "body mass index" OR "BMI" OR "adiposity") AND ("prevalence" OR "epidemiology" OR "burden") AND ("India" OR "Indian"). Reference lists of all eligible studies and relevant reviews were manually screened to identify potential studies missed during database searching.

Inclusion criteria

Studies were eligible for inclusion if they met the following criteria.

Population

Children and adolescents aged 0–19 years residing in India.

Outcome

Reported prevalence or proportion of overweight and/or obesity, defined using established criteria including WHO, IOTF, or CDC BMI-for-age cut-offs.

Study design

Cross-sectional, population-based, or cohort studies providing prevalence data or extractable proportions.

Time frame

Studies published from January 2015 to June 2025, in peer-reviewed journals. There were no language restrictions.

Exclusion criteria

Studies were excluded if they: focused on individuals aged >19 years; were intervention trials, case–control studies, reviews without original prevalence data, commentaries, conference abstracts, case reports and grey literature; restricted to disease-specific populations (such as children with chronic illnesses, disabilities, or genetic syndromes) or those using self-reported anthropometric data without validation were also excluded; or did not report prevalence or extractable proportions of overweight or obesity using

any recognized diagnostic criterion (WHO, IOTF, CDC, or IAP).

Study selection

All retrieved records were screened in a two-stage process. In the first stage, titles and abstracts were independently reviewed by two authors to exclude clearly irrelevant studies. In the second stage, full texts of potentially eligible articles were obtained and assessed against the predefined criteria. Discrepancies were resolved through discussion or consultation with a third reviewer. 17 full-text articles could not be retrieved despite reasonable efforts, including attempts to contact corresponding authors. The entire screening process was documented using the PRISMA 2020 flow diagram.

Data extraction and synthesis

A standardized data extraction template was developed in Microsoft Excel. Extracted information included study characteristics (author, year, state/region, and study design), sample size, participant demographics (age, sex, urban/rural setting), diagnostic criteria used, prevalence estimates for overweight and obesity, and factors associated with these outcomes, such as socioeconomic status, parental education, dietary habits, or physical activity levels. Data extraction was conducted independently by two reviewers. A narrative synthesis was undertaken first to summarize the distribution of studies across geographic regions, time periods, and methodological characteristics. Quantitative data suitable for pooling were subjected to meta-analysis to generate pooled prevalence estimates. Where pooling was not possible, findings were summarized descriptively.

Statistical analysis

Quantitative synthesis was performed using MedCalc software (version 23.1.1). Prevalence estimates were pooled and combined using a random-effects model (DerSimonian–Laird method) to account for between-study variability, which was the pre-specified primary model given the expected clinical and methodological diversity of included studies. Results were presented as pooled prevalence (%) with 95% confidence intervals (CIs). Heterogeneity was assessed using the I^2 statistic and Cochran's Q test, interpreted as: <25% low, 25–50% moderate, 50–75% substantial, and >75% considerable heterogeneity.

To explore sources of heterogeneity, pre-specified subgroup analyses were conducted by: gender (male versus female); diagnostic criterion used (WHO versus CDC versus IOTF versus IAP); and region (North, South, East, and Western India). Sensitivity analyses were performed by excluding studies with a high risk of bias or extreme prevalence estimates. Publication bias was evaluated using funnel plots and Egger's regression test, and Begg's rank correlation test.

Risk of bias assessment

The methodological quality of included studies was assessed using an adapted version of the Joanna Briggs Institute (JBI) critical appraisal checklist for prevalence studies.[19] This 9-item tool assesses key domains, including sample representativeness, adequacy of sample size, reliability of measurement methods, and appropriateness of statistical analyses. Each study was rated as having a low (7–9 criteria met), moderate (4–6 criteria met), or high (≤3 criteria met) risk of bias. Two reviewers independently performed the quality assessment. The majority of the studies were judged to be of low risk, supporting the robustness of the findings. The distribution of risk-of-bias ratings across included studies is reported in the results.

RESULTS

The systematic search across electronic databases and registers identified a total of 4,426 records, including 1,038 from PubMed, 262 from Google Scholar, 1,967 from ScienceDirect, and 1,159 from Ovid. After removal of 1,178 duplicate records, 3,248 unique records remained and were screened based on titles and abstracts. During this stage, 2,667 records were excluded for not meeting the predefined inclusion criteria and an additional 115 records were removed for other reasons. Consequently, 466 full-text articles were sought for retrieval, of which 17 reports could not be retrieved. The remaining 449 full-text articles were assessed for eligibility. Of these, 417 articles were excluded after full-text evaluation due to reasons including wrong outcome (n=186), inappropriate study design (n=62), wrong country setting (n=51), lack of disaggregated data relevant to the review objectives (n=33), and other reasons (n=85).

In addition to database searches, 15 studies were identified through cross-reference screening of eligible articles. Ultimately, 32 studies met all inclusion criteria from database searches, and together with studies identified through cross-referencing, a total of 47 studies were included in the final review.[20-66]

Study characteristics

A total of 47 studies published between 2015 and 2025 were included, collectively assessing the prevalence of pediatric overweight and obesity across India. The studies provided comprehensive national representation, covering the Northern (Delhi, Punjab, Haryana, Uttar Pradesh, Kashmir), Southern (Tamil Nadu, Kerala, Karnataka), Western (Maharashtra, Gujarat, Rajasthan), and Eastern (West Bengal, Odisha, Bihar, Jharkhand) regions, along with Northeastern states such as Assam (Figure 2).

Most studies adopted a cross-sectional design, predominantly school-based (n=43) and a few hospital-based (n=4). The WHO growth reference was the most commonly used diagnostic criterion (n=25) for classifying overweight and obesity, followed by the CDC (n=8), IOTF

(n=6), and IAP (n=6) criteria, while 2 studies employed mixed or locally adapted BMI-for-age percentiles. Sample sizes varied substantially, from fewer than 100 participants to over 5,000 in large population-based cohorts.

Studies primarily focused on children and adolescents aged 5–19 years. Male representation ranged between 40% and 70%, with most studies maintaining a near-equal gender distribution, indicating balanced inclusion of both sexes in the pooled analysis. Reported prevalence of overweight and obesity varied widely, reflecting urban–rural differences, socioeconomic disparities, and lifestyle heterogeneity across study populations. Key study characteristics are summarized in Table 1.

Socioeconomic, demographic, and lifestyle correlates of overweight and obesity

Across the included studies (2015–2025), a consistent direction of association was observed between higher socioeconomic position and increased prevalence of overweight and obesity among school-aged children and adolescents in India. Socioeconomic status, variably measured through parental education, father's occupation, household income, or school type, showed concordant findings across multiple settings, with private school attendance and indicators of household affluence repeatedly associated with higher risk. Urban residence similarly emerged as a recurrent contextual factor, suggesting the influence of urbanization and obesogenic environments.[21,24,25,30-32,40,46,48,52,56,65]

Associations with age and sex demonstrated inconsistency as several studies reported higher prevalence among boys while others identified greater vulnerability among adolescent girls.[20,26,30,35,37,42,53,57,64] Additionally, an overall age-related increase in prevalence was commonly reported.[36,37,47,59] Family-level factors, including nuclear family structure, lower birth order, and positive family history of obesity, were identified in multiple studies.[24,25,30,34,38,45,60]

Lifestyle and behavioral factors showed the strongest and most consistent qualitative evidence. Reduced physical activity (noted as <2 hours/day), increased sedentary behaviour (>2 hours/day of screen time), frequent consumption of energy-dense foods and sugar-sweetened carbonated beverages, breakfast skipping, and shorter sleep duration were repeatedly associated with overweight and obesity across geographic regions and study designs.[22-25,28-30,38-40,41,43,45,48,51,60,62,66] Several studies suggested that these behaviors were more prevalent in higher socioeconomic and private-school populations, indicating a potential interaction between affluence and lifestyle risk.

Due to substantial heterogeneity in exposure definitions, measurement tools, and analytical approaches, meta-analysis was not feasible. Nonetheless, the consistency in the direction and biological plausibility of reported associations across studies supports that socioeconomic context and lifestyle behaviours are the primary correlates of childhood overweight and obesity in India. A qualitative synthesis of these factors, as identified in the studies, is summarized in Table 2.

Pooled prevalence of obesity

All 47 studies (N=54,915) were included in the pooled analysis of obesity prevalence. Using a random-effects model, the pooled prevalence of obesity was 5.01% (95% CI: 4.25–5.83%; $p<0.0001$; $I^2=94.47\%$), indicating very high heterogeneity. Sample sizes varied widely, ranging from fewer than 50 to over 5,000 participants, and reported prevalence values ranged from below 2% to nearly 17%. Sensitivity analysis excluding the 4 hospital-based studies did not materially alter the pooled estimate. Sensitivity analysis excluding the two studies using only BMI cut-off criteria (without age-adjusted percentiles) similarly did not yield significant change in the pooled estimates.

Pooled prevalence of overweight

A total of 44 studies, comprising 49,445 participants, were included in the pooled analysis to estimate the prevalence of overweight among Indian children and adolescents. Using a random-effects model, the pooled prevalence of overweight was found to be 11.64% (95% CI: 9.83–13.57%; $p<0.0001$; $I^2=97.85\%$), indicating very high heterogeneity across the included studies. Sample sizes varied considerably, from fewer than 50 to over 5,000 participants. Reported prevalence rates varied widely, ranging from below 5% in specific rural cohorts to above 22% in some urban and private school-based studies. The marked heterogeneity ($Q=2096.24$, $df=45$, $p<0.0001$) reflects differences in population characteristics, geographic regions, and diagnostic criteria. Assessment of publication bias using Egger's regression test and Begg's rank correlation test showed no statistically significant evidence of publication bias for either outcome. Forest plots for obesity and overweight are presented in Figure 1.

Gender-based differences in obesity and overweight prevalence

Gender-stratified analyses revealed comparable yet marginally higher prevalence estimates of overweight and obesity among boys compared to girls. Among males (n=17,005), the pooled prevalence of obesity was 5.21% (95% CI: 4.14–6.39%; $I^2=90.28\%$), while the pooled prevalence of overweight was 11.02% (95% CI: 9.14–13.05%; $I^2=93.18\%$), indicating substantial heterogeneity across studies. In contrast, among females (n=14,653), the pooled prevalence of obesity was 4.58% (95% CI: 3.49–5.80%; $I^2=90.65\%$), and the pooled prevalence of overweight was 10.73% (95% CI: 8.31–13.43%; $I^2=95.66\%$). The combined gender-stratified sample (n=31,658) is smaller than the total pooled sample (n=54,915) because not all included studies reported sex-disaggregated prevalence data.

Table 1: Characteristics of studies included (2015–2025).

Author name	Title	Year	Location	Age	Sample size	Study design	Type	Geographic region	Male (%)	Standard	Obesity (%)	Overweight (%)
Pengoria et al, 2015[20]	Prevalence of overweight and obesity among school children	2015	Delhi	12-18	1590	Cross-sectional	School-based	Northern	58.40	WHO	2.8	10.2
Ghonge et al, 2015[21]	Prevalence of obesity and overweight among school children of Pune city, Maharashtra, India: a cross sectional study	2015	Pune	10-15	1281	Cross-sectional	School-based	Western	54.09	IOTF	5.6	9.9
Kumar et al, 2015[22]	Prevalence of obesity and its influencing factors in affluent school children of Tumkur: lessons from South India	2015	Tumkur	6-15	2000	Cross-Sectional	School-based	Southern	59	CDC	3.3	NA
Watharkar et al, 2015[23]	Assessment of risk factors for overweight and obesity among school going children in Kanpur, Uttar Pradesh	2015	Kanpur	12-15	806	Cross-Sectional	School-based	Northern	NA	WHO	3.9	9.8
Bhattacharya et al, 2016[24]	Prevalence and awareness of obesity and its risk factors among adolescents in two schools in a northeast Indian city	2016	Guwahati	10-19	60	Cross-sectional	School-based	Eastern	60	WHO	1.7	13.3
Bhargava et al, 2016[25]	Overweight and obesity in school children of a hill state in North India: is the dichotomy urban-rural or socio-economic? results from a cross-sectional survey	2016	Dehra-dun	6-17	1266	Cross-sectional	School-based	Northern	48.60	WHO	5.4	15.6
Chandrakala et al, 2016[26]	A study of prevalence of overweight and obesity in adolescents	2016	Benga-luru	12-18	500	Cross-sectional	Hospital-based	Southern	39	CDC	4.2	7
Eshwar et al, 2016[27]	Prevalence of obesity and overweight and their comparison by three growth standards among affluent school students aged 8-18 years in Rajkot	2016	Rajkot	8-18	1496	Cross-sectional	School-based	Western	79.10	WHO	11	15.3
Thaddanee et al, 2016[28]	Prevalence and determinants of obesity and overweight among school children of Ahmedabad	2016	Ahmeda-bad	10-15	2562	Cross-sectional	School-based	Western	54.09	IOTF	5.6	12.5

Continued.

Author name	Title	Year	Location	Age	Sample size	Study design	Type	Geographic region	Male (%)	Standard	Obesity (%)	Overweight (%)
	City, Gujarat: a cross sectional study											
Jain et al, 2016[29]	The study of obesity among children aged 5-18 years in Jaipur, Rajasthan	2016	Jaipur	5-18	1000	Cross-sectional	School-based	Western	56.40	CDC	5.6	9.9
Mackwana et al, 2016[30]	Predictors of overweight and obesity among school going adolescents of Vadodara city in Western India	2016	Vadodara	10-18	1050	Cross-sectional	School-based	Western	NA	WHO	2.7	7.8
Pawar et al, 2016[31]	Prevalence of overweight and obesity in 4 schools of South Mumbai	2016	Mumbai	10-16	1828	Cross-sectional	School-based	Western	67.70	IOTF	3.3	11.3
Prasad et al, 2016[32]	Prevalence of overweight and obesity among adolescent students in Pondicherry, South India	2016	Pondi-cherry	10-18	2465	Cross-sectional	School-based	Southern	53.10	WHO	4.3	9.7
Shanmugam et al, 2016[33]	Prevalence of overweight and obesity among children aged 5-15 years in a rural school in Coimbatore	2016	Coimba-tore	5-15	890	Cross-sectional	School-based	Southern	50.70	WHO	4.7	8.3
Arora et al, 2017[34]	Overweight and obesity in Ahmedabad school going children: magnitude in relationship to hypertension and associated risk factors	2017	Ahmeda-bad	12-17	373	Cross-sectional	School-based	Western	58.10	CDC	2.9	8.8
Shah et al, 2017[35]	Prevalence of childhood obesity in Anand district	2017	Anand	5-18	1034	Cross-sectional	School-based	Western	NA	IOTF	6.3	13.6
Das et al, 2017[36]	Prevalence of overweight and obesity among urban school children aged 5 to 10 years in North India	2017	Delhi	5-10	5643	Cross-sectional	School-based	Northern	58.50	IOTF	2.4	6.4
Ganie et al, 2017[37]	Prevalence, risk factors and consequences of overweight and obesity among schoolchildren: a cross-sectional study in Kashmir, India	2017	Kashmir	6-18	2024	Cross-sectional	School-based	Northern	43	CDC	4.6	6.6
Meharda et al, 2017[38]	Overweight and obesity: a rising problem in India	2017	Udaipur	15	1000	Cross-sectional	School-based	Western	50	WHO	2.4	8.2

Continued.

Author name	Title	Year	Location	Age	Sample size	Study design	Type	Geographic region	Male (%)	Standard	Obesity (%)	Overweight (%)
Srivastava et al, 2017[39]	A cross sectional study of the prevalence of obesity or overweight and its correlates among school children in a central India District	2017	Etawah	12-16	921	Cross-sectional	School-based	Northern	50.80	WHO	1.4	9.6
Dhanasekhar et al, 2017[40]	The prevalence of obesity and factors contributing to it in school going children between 5-12 years	2017	Chennai	5-12	4960	Cross-sectional	Hospital-based	Southern	49.11	WHO	4.1	22.1
Khandelwal et al, 2017[41]	Prevalence of obesity and overweight in private schools of Jaipur city in 11-17 year age group children	2017	Jaipur	11-17	1250	Cross-sectional	School-based	Western	57.12	CDC	6.2	12.9
Agarwal et al, 2018[42]	The prevalence of obesity in adolescent age group of district Harpur U.P. India	2018	Harpur	10-18	505	Cross-sectional	School-based	Northern	51	WHO	7.1	NA
Pathak. S. et al, 2018[43]	Prevalence of obesity among urban and rural school going adolescents of Vadodara, India: a comparative study	2018	Vadodara	10-18	224	Cross-sectional	School-based	Western	46.16	IAP	17.6	20.2
Yadav et al, 2018[44]	Prevalence of overweight, obesity and hypertension among school going children in District Kanpur, Uttar Pradesh, India: a longitudinal study	2018	Kanpur	12-16	350	Cross-sectional	School-based	Northern	60	CDC	2	4
Dabade et al, 2019[45]	Prevalence of overweight and obesity among school-going children of Satara district, Maharashtra	2019	Satara	15	360	Cross-sectional	School-based	Western	51.30	IAP	2.5	9.1
Gautam et al, 2019[46]	Childhood obesity and its associated factors among school children in Udupi, Karnataka, India	2019	Udupi	12-16	1185	Cross-sectional	School-based	Southern	49.80	WHO	6.2	10.8
Kumari, 2019[47]	Prevalence of overweight and obesity in indian adolescent school going children: a cross sectional study done in an urban area of Rohtas, Bihar	2019	Bihar	10-19	900	Cross-sectional	School-based	Eastern	52.70	IAP	5.8	18.5
Thakur et al, 2019[48]	Epidemiological study of obesity and overweight among	2019	Ghaziabad	10-19	1128	Cross-sectional	School-based	Northern	54.90	WHO	3.6	10.7

Continued.

Author name	Title	Year	Location	Age	Sample size	Study design	Type	Geographic region	Male (%)	Standard	Obesity (%)	Overweight (%)
	adolescents in schools in district Ghaziabad											
Anangamanjari et al, 2020[49]	Overweight and obesity among school-going adolescents in Bengaluru, South India	2020	Bengaluru	10-16	734	Cross-sectional	School-based	Southern	13.40	WHO	6.1	21.7
Gayathri et al, 2020[50]	Prevalence of overweight and obesity among adolescents in South Indian population	2020	Pondicherry	12-14	150	Cross-sectional	School-based	Southern	44.70	BMI	14	9.9
Singh et al, 2020[51]	Prevalence and associated factors of overweight/obesity among school going children in Chandigarh, India	2020	Chandigarh	10-14	1030	Cross-sectional	School-based	Northern	51.70	IAP	7.9	18
Goyal et al, 2021[52]	Prevalence of overweight and obesity among rural and urban school going adolescents (10-19 years) in North India: a population based study	2021	Haryana	10-19	1600	Cross-sectional	School-based	Northern	55.30	WHO	6	18
Muralidhar et al, 2021[53]	A clinical study on obesity in children in rural medical college	2021	Telangana	8-16	965	Cross-sectional	Hospital-based	Southern	46.11	WHO	8.6	NA
Seema et al, 2021[54]	Prevalence and contributing factors for adolescent obesity in present era: cross-sectional study	2021	Haryana	10-16	385	Cross-sectional	School-based	Northern	55	WHO	7.3	13.9
Viswambharan et al, 2021[55]	A cross sectional study on the prevalence of overweight and obesity in affluent school children of central Kerala	2021	Kerala	4-18	1104	Cross-sectional	School-based	Southern	54.30	WHO	6.8	17.1
Thomas et al, 2021[56]	Prevalence of overweight and obesity among school children in Mysuru, Karnataka	2021	Mysuru	11-15	440	Cross-sectional	School-based	Southern	54.50	WHO	3.8&	12.2
Khan et al, 2021[57]	Overweight and obesity among primary school going children in urban Agra: a cross-sectional study.	2021	Agra	6-10	200	Cross-sectional	School-based	Northern	57.50	WHO	3.5	16.5
Kumari et al, 2021[58]	Prevalence of overweight and obesity among school going adolescent in Patna	2021	Patna	8-15	660	Cross-sectional	School-based	Eastern	53	IOTF	10.9	18.1
Mohan et al, 2021[59]	A study on prevalence of overweight and obesity among	2021	Tamil Nadu	10-19	900	Cross-sectional	School-based	Southern	52.90	WHO	5.8	18.7

Continued.

Author name	Title	Year	Location	Age	Sample size	Study design	Type	Geographic region	Male (%)	Standard	Obesity (%)	Overweight (%)
	adolescent children in an urban field practice area of a teaching medical college in South India											
Nair et al, 2021[60]	Prevalence and determinants of overweight and obesity among urban school going adolescents in South Kerala - a community based cross sectional study	2021	Kerala	13-17	1100	Cross-sectional	School-based	Southern	49	CDC	3.5	11.3
Hedayetullah et al, 2022[61]	Prevalence of overweight and obesity among students of government and private high schools in an Indian state with significant tribal population: a cross-sectional analytical study	2022	Jhar-khand	11-18	1110	Cross-sectional	School-based	Eastern	47.74	WHO	3.1	9.3
Madanika et al, 2022[62]	Prevalence of overweight and obesity among rural school children aged between 6 years to 16 years	2022	Mandya	6-16	542	Cross-sectional	School-based	Southern	46.12	IAP	7	12.9
Pradhan et al, 2022[63]	Prevalence of obesity among adolescent school children in rural and urban South Odisha	2022	Odisha	13-18	180	Cross-sectional	School-based	Eastern	66.70	BMI	5	9.4
Bhattad et al, 2023[64]	Prevalence of overweight and obesity in school going children: a community based cross sectional study from Latur, Maharashtra	2023	Latur	12-16	500	Cross-sectional	School-based	Western	50	WHO	5	9.8
Kaushal et al, 2024[65]	Burden of overweight and obesity among children studying in schools of Western Rajasthan	2024	Jodhpur	12-15	1864	Cross-sectional	School-based	Western	55.70	WHO	3	22.9
Ahammad et al, 2025[66]	Study of prevalence of overweight and obesity among school going adolescents in north Karnataka and its association with life style changes	2025	Benga-luru	13-17	800	Cross-sectional	Hospital-based	Southern	58.90	IAP	5.5	28.8

WHO: World Health Organization, CDC: Centre for Disease Control, IOTF: International Obesity Task Force, IAP: Indian Academy of Pediatrics

Very high heterogeneity persisted within both gender subgroups (I^2>90%), indicating that sex alone does not account for the observed variability. Publication bias assessment showed no significant evidence of small-study effects. Forest plots for gender subgroup analyses are presented in Figure 2.

Subgroup analysis based on geography and diagnostic criteria

Subgroup analyses by region (North, South, East, West) were conducted as pre-specified. However, because the pooled prevalence differences across regions were modest (obesity range: 4.71–5.47%; overweight range: 9.39%–13.83%) and confidence intervals were largely overlapping.

Subgroup analysis by diagnostic criterion (WHO, CDC, IOTF, and IAP) was also conducted to explore whether the choice of BMI classification system contributed to the observed heterogeneity. Pooled prevalence estimates across the four diagnostic criteria were broadly comparable, with no statistically significant differences observed between subgroups. Heterogeneity remained substantial within each criterion subgroup, indicating that the diagnostic system used alone does not account for the between-study variability observed in the primary analysis.

Table 2: Summary of socioeconomic, demographic and lifestyle correlates of overweight and obesity.

Author name	Key significant socioeconomic and lifestyle correlates
Pengoria et al, 2015[20]	Male gender associated with higher risk of overweight (OR: 1.68, CI: 1.11–2.55)
Ghonge et al, 2015[21]	Higher obesity prevalence in private school children
Kumar et al, 2015[22]	Physical inactivity (<2 hours/day) linked with higher obesity
Watharkar et al, 2015[23]	Regular fast food, soft drink intake, and >2 hours/day screen time associated with obesity
Bhattacharya et al, 2016[24]	Private schooling, nuclear family, junk food consumption, lack of exercise linked with obesity
Bhargava et al, 2016[25]	Higher obesity in nuclear families, urban schooling, lower birth order, high parental education and occupation
Chandrakala et al, 2016[26]	Females more obese and overweight
Thaddanee et al, 2016[28]	>2 hour/day screen time and calorie intake above RDA associated with obesity
Jain et al, 2016[29]	Frequent junk food intake (>3 times a week) and <1 hour/day physical activity linked with obesity
Mackwana et al, 2016[30]	Male gender, English-medium schooling, family obesity, sedentary lifestyle, outside food, and sleep deprivation linked with obesity
Pawar et al, 2016[31]	Obesity more prevalent in private schools
Prasad et al, 2016[32]	Obesity more prevalent in private schools
Arora et al, 2017[34]	Higher SES, family history and elevated blood pressure observed in children with overweight and obesity
Shah et al, 2017[35]	Obesity more prevalent in urban boys
Das et al, 2017[36]	Obesity prevalence increases with age
Ganie et al, 2017[37]	Obesity more prevalent in boys
Meharda et al, 2017[38]	Obesity linked with sleep deprivation, working status of mother and a family history of overweight and obesity
Srivastava et al, 2017[39]	Watching television, playing video games, fast food intake, number of time breakfast slip and mean soda intake linked to obesity
Dhanasekhar et al, 2017[40]	Higher SES, father's occupation (service/business), junk food intake linked with obesity
Khandelwal et al, 2017[41]	Consumption of high calorie food regularly and low physical activity linked to obesity
Agarwal et al, 2018[42]	Obesity prevalent in urban males
Pathak et al, 2018[43]	Higher income, canteen/restaurant food, fewer physical exercise sessions associated with obesity
Yadav et al, 2018[44]	Prevalence of pre-hypertension and hypertension is more among overweight and obese children
Dabade et al, 2019[45]	Family history of obesity, working status of mother, and less duration of sleeping directly linked to obesity

Continued.

Author name	Key significant socioeconomic and lifestyle correlates
Gautam et al, 2019[46]	Private schooling (AOR: 2.87, CI: 1.55–5.31), father's business occupation (AOR: 2.43, CI: 1.05–5.62) linked to obesity
Kumari, 2019[47]	Age and SES associated with obesity
Thakur et al, 2019[48]	Higher obesity with urban residence, fast foods, carbonated drinks, low activity
Gayathri et al, 2020[50]	Higher screen time, less outdoor physical activities and non-vegetarian diet linked to obesity
Singh et al, 2020[51]	Obesity linked to SES and reported physical activity
Goyal et al, 2021[52]	Higher prevalence in urban areas, private schools, nuclear families, and upper SES
Muralidhar et al, 2021[53]	Higher prevalence in girls
Seema et al, 2021[54]	Gender, SES, dietary habits, chocolate eating habits, mode of transportation to school, sports participants, physical activity, and screen time linked to obesity
Thomas et al, 2021[56]	Prevalence higher among children from higher SES
Khan et al, 2021[57]	Obesity prevalent in boys and urban students
Mohan et al, 2021[59]	Age and SES linked with overweight and obesity
Nair et al, 2021[60]	High SES, >8 hours/week TV, fatty foods, family obesity, motor vehicle transport linked with obesity
Hedayetullah et al, 2022[61]	Obesity and overweight more prevalent in boys and students with private schooling
Madanika et al, 2022[62]	SES, parental obesity, type of food consumption, screen time, daily physical activity in children linked to obesity
Pradhan et al, 2022[63]	Junk food, carbonated beverages, eating out, skipping breakfast, and sedentary habits associated with obesity
Bhattad et al, 2023[64]	Obesity prevalent in boys
Kaushal et al, 2024[65]	Obesity more prevalent in urban public schools
Ahammad et al, 2025[66]	High-calorie diet, screen time, low physical activity, and family history linked with obesity

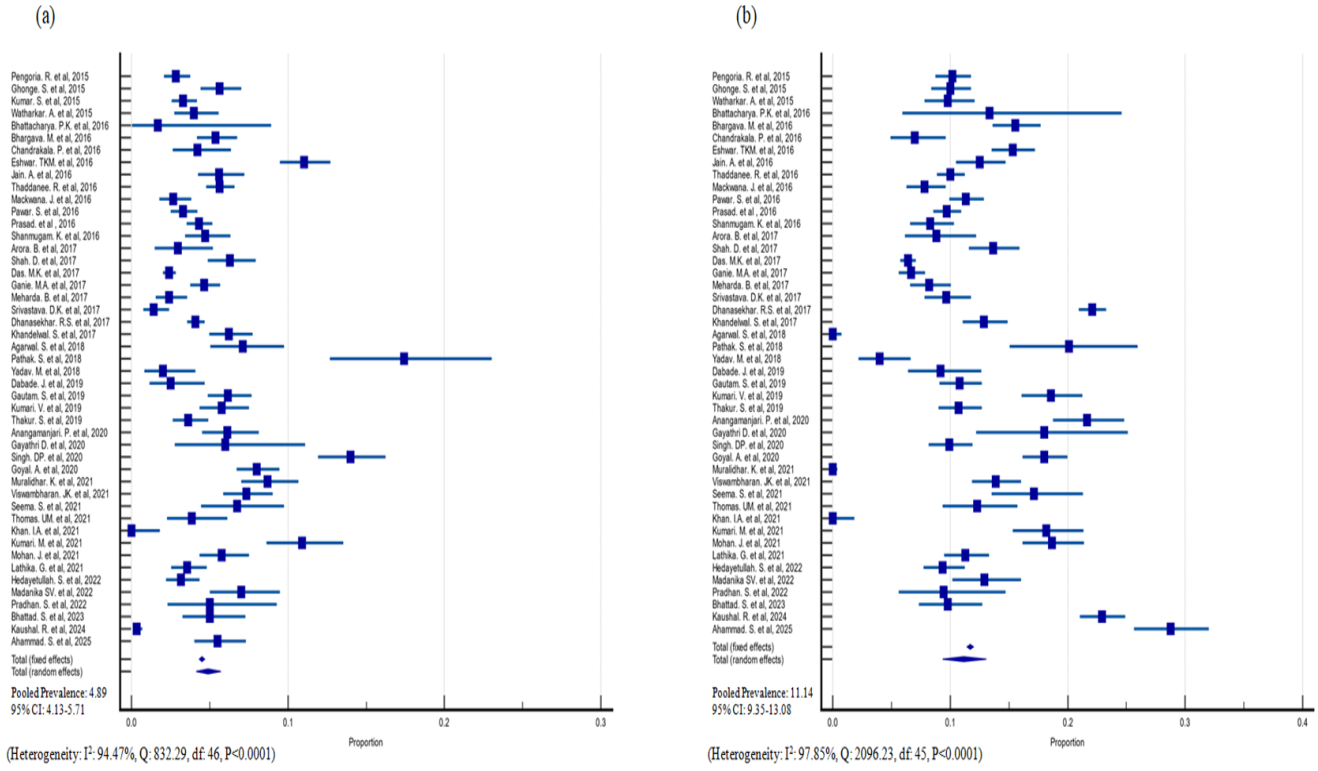

Figure 1: Forest plots depicting pooled prevalence estimates of (a) obesity and (b) overweight among Indian children and adolescents.

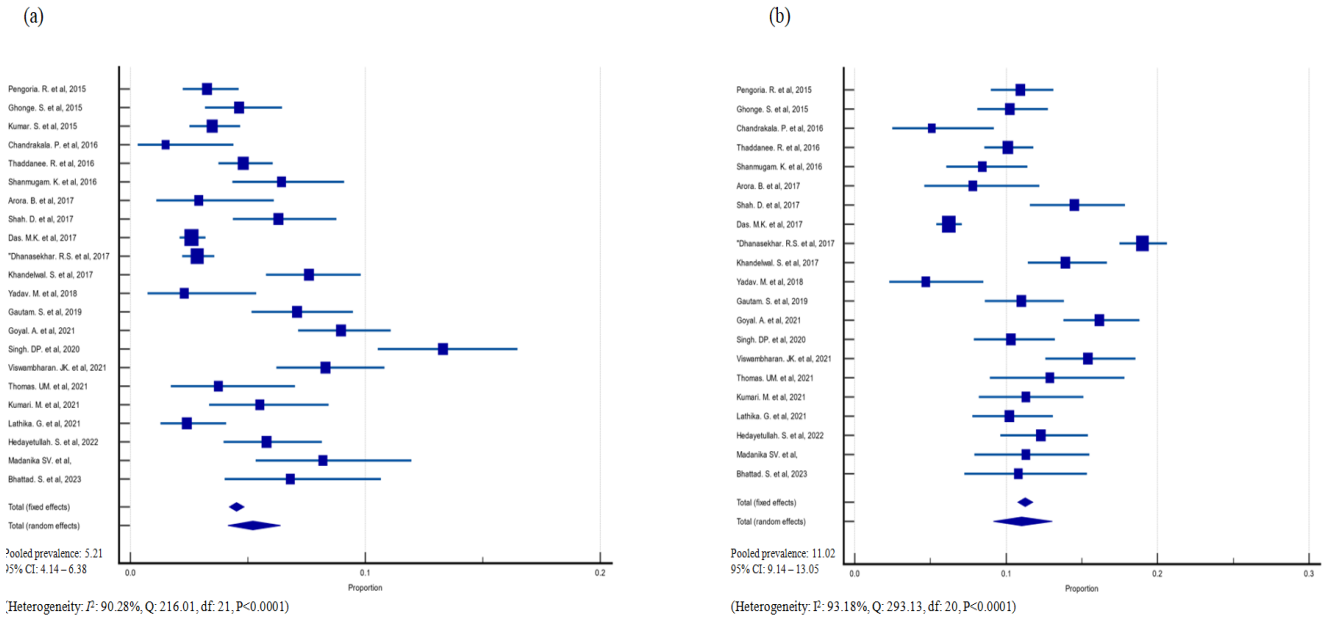

Figure 2: Pooled prevalence estimates of (a) obesity among boys and (b) obesity among girls.

DISCUSSION

This systematic review and meta-analysis provides a comprehensive synthesis of the burden of overweight and obesity among Indian children and adolescents over the past decade (2015-2025). This period reflects a phase of rapid nutritional and lifestyle transition characterized by increasing urbanization, dietary shifts toward energy-dense processed foods, and growing sedentary behavior among children.[67-69]

The pooled prevalence of obesity was 5.01% (95% CI: 4.25–5.83%), while the pooled prevalence of overweight was 11.64% (95% CI: 9.83–13.57%), corresponding to approximately 1 in 20 and 1 in 9 Indian children, respectively. These findings are broadly consistent with previous systematic reviews, although meaningful differences exist. A recent two-decade meta-analysis of only 21 studies including 186,901 children from India estimated pooled prevalence of 8.4% for obesity and 12.4% for overweight.[70] Similarly, another systematic review of Indian studies reported wide variation in prevalence, with overweight ranging from 2.28% to 21.9% and obesity from 2.4% to 17.6%, reflecting differences in population characteristics, geographic coverage, and diagnostic criteria.[71] Across Asian countries, pooled prevalence estimates have been reported at approximately 5.8%, suggesting that the Indian estimates observed in this review fall within the broader regional range.[6] Although these estimates appear modest compared with some high-income countries, they translate into a substantial absolute number of affected children given India's large population base.

A central finding of this meta-analysis is the very high heterogeneity observed across studies (I^2>90% for both outcomes), which likely reflects epidemiological diversity rather than statistical artefact alone. India's marked regional, socioeconomic, cultural, and dietary heterogeneity contributes substantially to variability in prevalence estimates. Subgroup analyses by gender partially explained this variation as boys showed marginally higher prevalence than girls, but heterogeneity persisted even within gender subgroups (I^2>90%), indicating that additional unmeasured contextual factors, including urbanization intensity, school type, dietary environments, and state-level policy, influence childhood adiposity patterns. Meta-regression on pre-specified covariates (urban/rural ratio, age band, diagnostic criterion) was not performed and represents a limitation and an opportunity for future analyses with larger study pools.

Methodological diversity further contributed to between-study variability. Although most studies employed WHO growth references, others used CDC, IOTF, or IAP criteria, each with different BMI-for-age cut-offs, potentially generating non-comparable prevalence estimates. Differences in sampling frames, predominantly school-based with limited rural representation, may also have inflated pooled estimates, particularly where private school populations were overrepresented. Age bands varied widely, with some studies including narrow age ranges and others spanning 5–19 years, limiting comparability. Additionally, cross-sectional designs dominated the evidence base, precluding causal inference and potentially introducing temporal bias. Despite these limitations, sensitivity analyses did not materially alter pooled estimates, supporting the robustness of the overall findings.

Gender-stratified analyses revealed slightly higher pooled prevalence among boys compared with girls. While this pattern aligns with some national and global observations,

the magnitude of difference was small and accompanied by substantial heterogeneity. Cultural norms influencing physical activity, dietary autonomy, may differentially affect boys and girls across regions. Notably, some previous individual studies reported higher adolescent female vulnerability, suggesting that gender disparities may shift with age and sociocultural context.[72,73]

Socioeconomic and lifestyle correlates demonstrated a consistent directional pattern across studies. Higher socioeconomic position, private school attendance, and urban residence were repeatedly associated with greater overweight and obesity prevalence, reflecting nutrition transition and lifestyle modernization. Behavioral factors such as reduced physical activity, excessive screen time, frequent intake of energy-dense foods and sugar-sweetened beverages, breakfast skipping, and short sleep duration, were the most consistently reported modifiable correlates. However, meta-analysis of these determinants was not feasible due to heterogeneous exposure definitions, inconsistent measurement tools, varied statistical adjustments, and lack of standardized reporting of effect estimates. The predominance of unadjusted or differently adjusted analyses across studies further limited quantitative synthesis of risk factors.

Overall, the findings highlight that India is experiencing a measurable rise in childhood overweight and obesity, driven largely by socioeconomic transition and lifestyle change. The coexistence of persistent under nutrition alongside increasing obesity reflects a complex double burden of malnutrition. Public health strategies must therefore move beyond isolated awareness campaigns toward integrated, school- and community-based interventions promoting healthy diets, physical activity, and sleep hygiene, particularly in rapidly urbanizing and higher-income settings. Future research should prioritize nationally representative, longitudinal studies using standardized BMI criteria and harmonized exposure definitions to enable more precise trend analysis and causal inference.

Strengthening surveillance systems and including obesity monitoring within existing child health programs will be critical to preventing escalation of this emerging epidemic.

Strengths and limitations

This review synthesizes recent data from across India using rigorous methods. It provides updated pooled prevalence estimates from both community and school-based studies and highlights demographic trends. However, several limitations should be acknowledged. First, nearly all included studies were observational and predominantly cross-sectional in design; therefore, causal inferences regarding determinants of overweight and obesity cannot be established. Second, the meta-analysis demonstrated very high statistical heterogeneity (I^2>90%), which likely reflects genuine variability in study populations, geographic contexts, sampling frames, and diagnostic criteria used to define overweight and obesity (WHO, IOTF, CDC, and IAP standards). Although subgroup analyses by gender and diagnostic criterion were performed to explore this heterogeneity, meta-regression was not conducted, and residual heterogeneity remains unexplained.

Furthermore, a large proportion of the included studies were school-based and conducted in urban or peri-urban settings, which may limit representativeness of rural populations and children from lower socioeconomic backgrounds. This sampling pattern could potentially overestimate national prevalence estimates, as urban and higher-SES populations often demonstrate higher obesity risk. This may have led to overestimating national prevalence. Despite these limitations, the review provides a comprehensive and overview of the burden of childhood overweight and obesity in India in the last decade.

CONCLUSION

In conclusion, our meta-analysis indicates that roughly 1 in 9 Indian children is overweight and about 1 in 20 is obese, that reflect a significant epidemiological burden over the past decade These rates are elevated compared to past data, reflect slightly higher risk among boys and in the South/East. Socioeconomic affluence, urban residence, private schooling, sedentary behavior, and unhealthy dietary patterns are the most consistently identified modifiable correlates of childhood overweight and obesity across India. Continued epidemiological monitoring using standardized diagnostic criteria, longitudinal study designs, and inclusive sampling that captures rural and lower-income populations will be critical to understanding temporal trends and guiding targeted prevention strategies for this growing epidemic.

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