Research Article

PREVALENCE OF CHILDHOOD OBESITY AND OVERWEIGHT IN INDIA: A META-ANALYSIS

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ABSTRACT

Background: A critical global health concern, particularly in low- and middle-income countries like India, is the rise of childhood obesity. The rising prevalence of obesity among children in these regions poses significant challenges for public health systems, as it is associated with adverse health outcomes such as diabetes, cardiovascular diseases, and psychological issues. This meta-analysis provides a comprehensive overview of childhood obesity prevalence in India. By systematically reviewing and synthesizing data from various studies, it identifies key risk factors contributing to childhood obesity in these settings. Understanding these factors is crucial for developing targeted interventions and policies to curb the growing epidemic and promote healthier lifestyles among children in India.

Methods: A thorough literature search was conducted using PubMed, Embase, and Scopus to identify relevant English-language studies published in the last decade. The inclusion criteria focused on research conducted in India, examining children and adolescents aged 0-18 years, and reporting on the prevalence of childhood obesity or its risk factors. Ten cross-sectional studies met these criteria, providing a robust dataset for the meta-analysis.

Results: The analysis reveals a significant disparity in childhood obesity prevalence between urban and rural areas in India. Urban regions show a higher prevalence, with a pooled estimate of 9.0% (95% CI: 2.0 to 17), compared to 4.0% (95% CI: 4.0 to 5.0) in rural areas. In urban settings, risk factors include poor dietary choices, limited physical activity, higher socioeconomic status, parental education, and private school attendance. In rural areas, factors such as gender, age, and household size are associated with obesity prevalence.

Discussion: These findings highlight the need for interventions tailored to the specific conditions of urban and rural areas to address disparities in childhood obesity prevalence. Urban strategies should promote healthy dietary habits and increase opportunities for physical activity, while rural interventions must consider unique challenges and cultural contexts. Future research should incorporate regional and cultural distinctions to develop more effective public health strategies.

Conclusion: This meta-analysis offers critical insights into childhood obesity prevalence and its risk factors across India, emphasizing the importance of customized interventions and lifestyle modifications to mitigate this growing public health issue and address health disparities.

KEYWORDS

Childhood obesity, public health strategies, lifestyle changes, targeted interventions, dietary habits, physical activity, health disparities, regional differences, cultural factors, intervention programs, obesity risk factors, preventive measures.

INTRODUCTION

Childhood obesity has emerged as a critical public health issue worldwide in the 21st century. Over recent decades, its prevalence has climbed alarmingly in both developed and developing nations. While obesity was once primarily associated with high-income countries, recent data reveal that it is also a growing concern in

low- and middle-income countries (LMICs). This global surge in childhood obesity not only affects children's health and well-being but also signals substantial future economic and healthcare burdens on societies. In 2019, the World Health Organization (WHO) reported that over 38 million children under five were overweight, with more than 340 million children and adolescents aged 5-19 classified as overweight or obese in 2016 (1). The World Obesity Federation also noted a doubling of childhood overweight and obesity rates in LMICs, from around 8.5% in 1980 to over 20% by 2020 (2). This rapid escalation is particularly alarming, as only 4% of children were overweight in the 1970s, a figure that rose to over 18% by 2016, according to the NCD Risk Factor Collaboration (3). These statistics reflect an unprecedented increase, presenting a formidable public health challenge.

This global rise in childhood obesity has complex origins, including dietary shifts, sedentary lifestyles, and changing environments. Worldwide, diets have shifted toward energy-dense foods high in fats, sugars, and salt, but low in essential nutrients such as vitamins and minerals (4). Concurrently, there has been a decline in physical activity due to more sedentary work, leisure activities, and modes of transportation (5). Urbanization further compounds these issues, as cities often promote less active lifestyles and offer easier access to unhealthy food options. Children in urban settings are more likely to engage in sedentary activities, such as television, video games, or smartphone use, which contributes to obesity rates (5).

Beyond lifestyle factors, childhood obesity is influenced by genetic, psychological, and socio-environmental factors. While genetics can predispose individuals to obesity, it is the interplay with environmental and lifestyle factors that primarily shapes outcomes. Psychological factors, including stress, depression, and anxiety, have also been associated with childhood obesity, with some children turning to food for comfort. Socio-environmental elements, such as parental influence, socioeconomic status, and access to health education, are equally crucial. For instance, children from wealthier backgrounds or those in private schools may have easier access to unhealthy food, such as sugary snacks and fast food, which can lead to higher obesity rates (6).

The health impacts of childhood obesity are significant and often persist into adulthood. Obese children are more likely to develop non-communicable diseases (NCDs), such as type 2 diabetes, cardiovascular disease, and musculoskeletal disorders (6). These conditions, once primarily adult health concerns, are increasingly diagnosed at younger ages. Additionally, childhood obesity is linked to psychosocial challenges, including low self-esteem, depression, and social isolation (7). Obese children may experience discrimination or bullying, leading to psychological distress and potentially lower academic achievement. As these children grow, they carry these health and psychosocial risks, increasing their likelihood of premature death and disability.

Economically, the increase in childhood obesity places significant strain on global healthcare systems. The medical costs related to treating obesity-related illnesses are high, and the productivity losses from ill health exacerbate this burden (8). Many countries already face healthcare shortages, and the rising number of obese children threatens to intensify this strain. Additionally, the societal costs—such as lost educational and economic opportunities—underscore the need for urgent interventions.

Once seen as a concern for affluent nations, childhood obesity is now rapidly increasing in LMICs. This trend is largely due to the globalization of unhealthy behaviours, resulting in drastic shifts in dietary and physical activity patterns. In these regions, traditional, fibre-rich, low-fat diets are being replaced with Westernized diets high in processed foods, fats, and sugars (9). Simultaneously, technological advances and urbanization have reduced physical activity in daily and leisure activities. Children increasingly spend time in sedentary activities, such as watching television or using digital devices, rather than engaging in physical play (10).

India serves as a compelling example of this trend in an LMIC. The country is experiencing a swift epidemiological transition, with rising rates of NCDs like obesity, diabetes, and cardiovascular disease, particularly in urban areas (11). Childhood obesity in India is now more prevalent in urban than rural regions, likely due to differences in lifestyle, dietary habits, and access to healthcare and education. Urban children are more likely to consume energy-dense, nutrient-poor foods and engage in sedentary activities, while rural children often maintain traditional diets and active lifestyles that offer some protection against obesity (12).

Nonetheless, obesity is also on the rise in rural India, as development brings lifestyle changes. Processed foods are more accessible, and rural children are exposed to similar unhealthy influences as their urban counterparts (13). This shift erodes the protective factors traditionally associated with rural living, leading to a convergence in obesity rates between urban and rural areas.

The rise of childhood obesity in India has serious implications for its future health and economic landscape. Obese children are at a higher risk for NCDs, including type 2 diabetes and cardiovascular disease, which put a significant strain on healthcare resources. In India, where healthcare systems are already limited, this growing obesity epidemic threatens to exacerbate these pressures (14). Childhood obesity also has long-term effects on mental health and academic performance, impacting future economic productivity and quality of life.

National Family Health Surveys (NFHS) in India show an increasing trend of obesity among children and adolescents, particularly in urban areas, which reflects the broader global shift toward unhealthy lifestyles. India's rapid urbanization and economic growth have amplified these trends, and childhood obesity is likely to continue rising unless immediate action is taken to address its root causes (15).

A key obstacle to tackling childhood obesity in India is the scarcity of comprehensive, national data on its prevalence and risk factors (16). Although studies on childhood obesity exist, they often focus on specific regions or groups, making it difficult to understand the broader picture. This meta-analysis aims to fill this gap by synthesizing existing research on childhood obesity in India, focusing on both urban and rural areas. By offering a comprehensive overview, this analysis intends to guide policymakers and public health advocates toward effective strategies for tackling this issue.

Effective public health interventions to prevent and reduce childhood obesity in India must consider the country's unique socio-cultural landscape. For example, interventions in urban areas should focus on reducing processed food consumption and encouraging physical activity in sedentary environments. In rural areas, interventions may need to counter the rising availability of unhealthy foods while promoting traditional, more active lifestyles.

Moreover, initiatives should address the socioeconomic disparities between different Indian regions and populations. Children from lower-income families face unique challenges in accessing nutritious food and opportunities for physical activity compared to wealthier children (17).

Addressing the long-term impacts of childhood obesity requires not only immediate health interventions but also economic and societal considerations. Childhood obesity can affect workforce readiness and overall productivity. By investing in prevention and early intervention, India can reduce the long-term costs associated with obesity and ensure a healthier future for its citizens (18,19).

In sum, childhood obesity is a growing public health concern in India, with significant implications for the country's future health and economic well-being. Driven by shifts in diet, activity, and the globalization of unhealthy behaviours, this issue demands a comprehensive, multi-sectoral approach that accounts for India's unique social and economic landscape. Targeted interventions and public health initiatives offer the best chance for India to curb the rise in childhood obesity and protect the health of future generations.

METHODOLOGY

Search Strategy

To conduct the literature search, a comprehensive search strategy was developed using the SPIDER (Sample, Phenomenon of Interest, Design, Evaluation, Research type) framework (20,21). The search terms used are presented in the following tables.

Table 1: SPIDER Framework for Literature Search Terms

Element	Description	Search Terms
Sample	Children in urban and rural areas of India	Children, Adolescents, Youth, School-aged
Phenomenon of Interest	Obesity and associated risk factors	Obesity, Overweight, Body Mass Index, BMI
Design	Studies examining prevalence and/or risk factors	Cross-sectional, Cohort, Case-control, Survey
Evaluation	Measurement of obesity and identification of risk factors	Prevalence, Incidence, Risk factors, Determinants
Research type	Both quantitative and mixed method research	Quantitative, Study

Table 2: Search Strategy

Search term	Description
(childhood OR pediatric) AND (obesity OR overweight)	Search terms for childhood obesity
(India OR Indian)	Search term for location
(urban OR rural)	Search term for setting
(prevalence OR incidence)	Search term for outcome measure
(risk factors OR determinants)	Search term for study design

The search strategy was conducted in PubMed, Embase, and Scopus, which are among the most reputable and comprehensive health and biomedical research databases (22-23). PubMed is a premier database for biomedical literature, encompassing a vast range of topics relevant to the study's focus on childhood obesity (22). Embase's strong emphasis on pharmacology and drug research provides extensive literature on clinical and medical interventions, which is invaluable for understanding obesity treatment and prevention (23). Scopus, being one of the largest abstract and citation databases, offers broad interdisciplinary coverage, ensuring a comprehensive scope for collating varied research on obesity (23).

The search results were screened for eligibility based on the inclusion and exclusion criteria, and the quality of the included studies was assessed using the Cochrane Risk of Bias Tool (25). The data extraction process was conducted using a standardized data extraction form, and the extracted data were analysed using descriptive statistics and meta-analysis (26).

Inclusion Criteria

Inclusion and exclusion criteria are essential components of a systematic review, ensuring consistency, relevance, and rigor. They provide clear guidelines for identifying pertinent studies, eliminating

potential biases, and addressing the research question comprehensively. Moreover, they enhance the review's transparency and replicability, establishing trust in the findings (21). This study adopted the following inclusion criteria:

- Geographical context: Studies conducted in India, focusing on either urban or rural settings, or both.
- Target population: Studies examining children and adolescents up to the age of 18 years.
- Outcomes of interest: Studies that report on the prevalence of childhood obesity or identify specific risk factors associated with childhood obesity in India.
- Study types: Both mixed-method studies and quantitative primary research studies, including cross-sectional, cohort, case-control, and observational studies.
- Publication language: Studies published in English.
- Time frame: Studies published in the last ten years to ensure relevance and capture recent trends and developments.

Exclusion Criteria

- Out of scope: Studies focusing on adult obesity without separate data for the child and adolescent age group.
- Geographical irrelevance: Studies that are not specific to India or do not differentiate results between India and other countries.
- Unrelated outcomes: Studies that discuss childhood weight or nutrition but do not specifically report obesity prevalence or associated risk factors.
- Review articles: Systematic reviews, literature reviews, meta-analyses, and other secondary publications.
- Non-empirical studies: Opinion pieces, editorials, and commentaries without original research data
- Language barrier: Studies not published in English and for which a reliable translation is unavailable.

Quality Assessment

Studies meeting a predetermined threshold of quality criteria were included in the review, ensuring that the synthesized findings are both reliable and valid. The "Strengthening the Reporting of Observational Studies in Epidemiology" (STROBE) checklist was used to appraise the studies (26). The checklist includes critical reporting suggestions for the study heading, abstract, introduction or background, utilized methods in each study, findings of the studies, and discussion. Each paper's quality is presented in Appendix 3.

Data Extraction

Initially, a standardized data extraction form was designed, capturing pertinent details such as authors, publication year, study design, and key findings among others (27). The form's effectiveness was evaluated through pilot testing on select studies, allowing for refinements as needed (28). The compiled data was meticulously documented, with digital tools like spreadsheets facilitating organization (29). As a quality control measure, a random subset of studies underwent a cross-check to validate the extraction process's accuracy.

Data Synthesis and Analysis

Data synthesis and analysis in systematic reviews are pivotal for amalgamating disparate pieces of information into a cohesive understanding of the studied phenomenon. Narrative synthesis was used to summarize the findings of the selected studies and to meet the objectives of this research study. Pooled prevalence was also assessed. I^2 value was assessed to find out the heterogeneity level of the studies. A forest plot was also created.

RESULTS

Study Selection

The study selection process was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (30). A PRISMA chart (Figure 1) was used to summarize the overall study selection process.

The search strategy identified 861 records, which were then screened for duplicates. A total of 294 duplicate records were removed, leaving 567 unique records. These records were then screened based on the eligibility criteria outlined in the methodology chapter, resulting in the removal of 334 records.

The remaining 233 full reports were assessed for eligibility, and some were deemed ineligible due to their evident ineligibility. After this stage, 10 articles were identified as eligible and selected for this study. All the selected articles were quantitative studies.
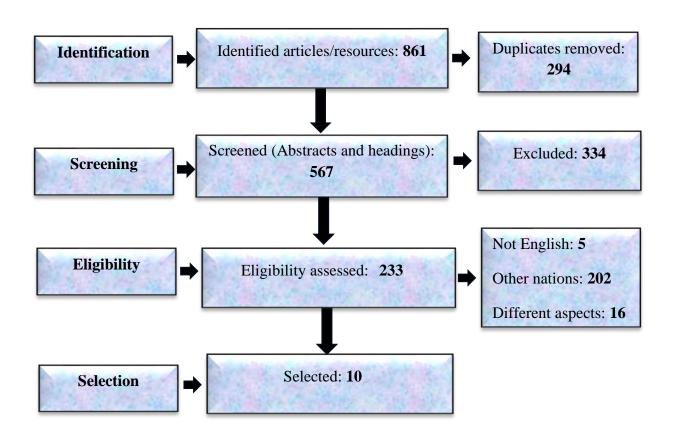
Figure 1: Study selection approach

Study Characteristics

Ten research studies, all employing a cross-sectional design, were included in this review. All studies focused on children or adolescents aged 18 or younger. The specific age groups of participants in each study are detailed in Appendix 2. Table 3 provides information on the study settings, including urban or rural locations, for the ten research studies.

Table 3: Study settings

Study	Study location	Setting information
(30)	Jaipur, Rajasthan	Urban
(38)	Pune, Maharashtra	Urban
(39)	Ganjam, Odisha	Urban and rural
(33)	Chennai, Tamilnadu	Urban

(34)	Vadodara, Gujarat	Urban and rural
(35)	Trichy, Tamilnadu	Rural
(32)	Kanchipuram, Tamilnadu	Rural
(36)	Coimbatore, Tamilnadu	Rural
(37)	Bangalore, Karnataka	Rural
(31)	Trissur, Kerala	Urban

As shown in Figure 2, the sample sizes of the studies included in this review ranged from 100 to 1842 participants. The 10 research studies employed various random sampling methods to recruit eligible study subjects, as detailed in Appendix 2.
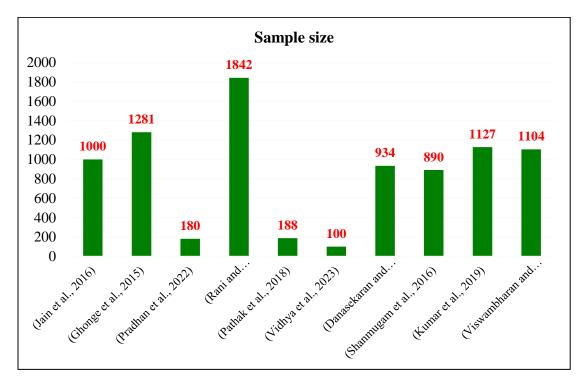

Figure 2: Sample sizes of selected studies

BMI was calculated for all participants in the included studies, along with the administration of other relevant tools and questionnaires. Descriptive and inferential statistics were employed to identify the prevalence and risk factors of childhood obesity. Ethical standards were adhered to in most of the investigations.

Prevalence of Childhood Obesity

The total prevalence, as well as urban-rural and gender-based prevalence, were reported. The reported total prevalence among the ten studies ranged from 4.08% to 7.30%, with a mean (SD) of 6.5 (3.9). The specific prevalence rates for each study are as follows: 5.60% (30), 5.62% (38), 5.00% (39), 5.20% (33), 17.60% (34), 6.00% (35), 4.40% (32), 4.72% (36), 4.08% (37), and 7.30% (31).

Urban-Rural Disparities

Eight of the ten studies focused exclusively on either rural or urban settings, while two studies reported on both. In rural areas, the prevalence of childhood obesity ranged from 2.20% to 6.00%, with a mean (SD) of 4.12 (1.2). In urban areas, the prevalence ranged from 5.2% to 31.3%, with a mean (SD) of 10.2 (10.3). The prevalence rates for both rural and urban settings are depicted in Figure 3.
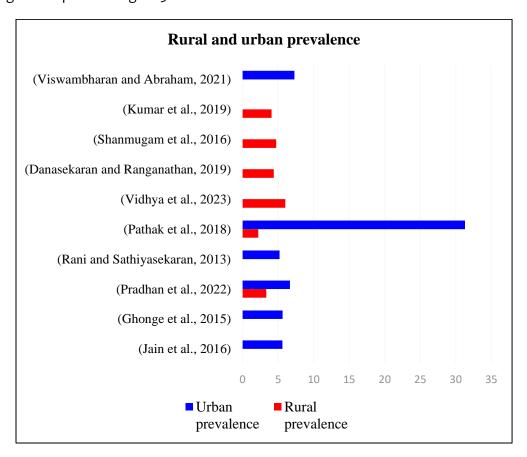

Figure 3: Rural vs urban prevalence of childhood obesity

Pooled prevalence: Rural and urban

Urban

The pooled prevalence of obesity in children from urban areas was estimated to be 9.0% (95% CI: 2.0 to 17), as shown in Figure 4. The results of the I^2 statistic (99.06%) indicate a high level of heterogeneity between the studies, which is statistically significant (p-value < 0.001).

Random-Effects Model (k = 6)

	Estimate	se	Z	p	CI Lower Bound	CI Upper Bound
Intercept	0.0949	0.0358	2.65	0.008	0.025	0.165
	.	.	.	.	.	.

Note. Tau² Estimator: Restricted Maximum-Likelihood

Heterogeneity Statistics

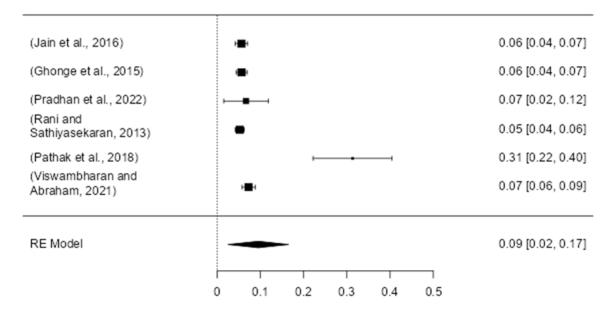| Tau	Tau²	I²	H²	R²	df	Q	p
0.085	0.0073 (SE= 0.0049)	99.06%	105.949	.	5.000	34.904	< .001

Figure 4: Forest plot of urban settings

Rural

As demonstrated in Figure 5, the pooled prevalence of obesity in rural children is 4.0% (95% CI: 4.0 to 5.0). The I^2 value of 0.0% suggests that there is no significant heterogeneity among the studies, indicating a high degree of consistency

in the findings. While this may seem counterintuitive given the diversity of the included studies, it could be attributed to several factors, such as the relatively small number of studies, the similarity in study designs, or the limited variation in the prevalence of childhood obesity across the included rural regions.

Random-Effects Model (k = 6)

	Estimate	se	Z	p	CI Lower Bound	CI Upper Bound
Intercept	0.0425	0.00355	12.0	< .001	0.036	0.049
	.	.	.	.	.	.

Note. Tau² Estimator: Restricted Maximum-Likelihood

Heterogeneity Statistics

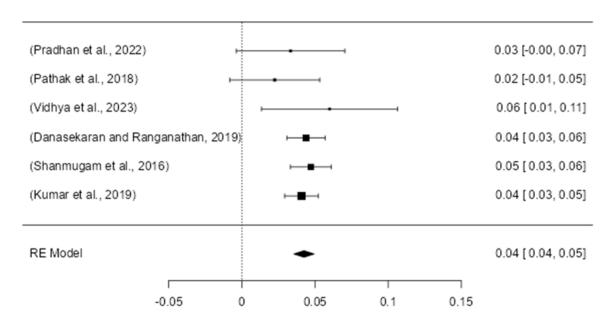| Tau	Tau²	I²	H²	R²	df	Q	p
0.000	0 (SE= 0)	0%	1.000	.	5.000	2.963	0.706

Figure 5: Forest plot of rural prevalence

Gender-Based Prevalence

While gender-based prevalence was reported in only three studies (30,31,38), all conducted in urban settings, significant disparities were observed. Urban male children had a higher prevalence of obesity [mean (SD): 10.27 (6.8)] compared to urban female children [mean (SD): 9.53 (5.53)]. In rural settings, gender

differences were less pronounced, with similar prevalence rates for male and female children.

Critical appraisal of selected studies

This meta-analysis of ten research studies examined the prevalence and risk factors for childhood obesity in India. The STROBE checklist was employed to evaluate the methodological rigor of these studies.

Although each study demonstrated notable strengths, areas for enhancement were identified. Several studies (29) provided a clear outline of their design, though some (30) would benefit from a more explicit hypothesis statement.

Confounding factors were not fully addressed in some cases, with study (30) omitting potential confounders that could significantly influence study depth. Contributions from rural perspectives by studies (31) and (32) enriched the research landscape. However, there was inconsistency in the handling of potential biases. While study (32) addressed certain biases, some studies could have improved their statistical reporting, particularly around confounding adjustments. Study (33) demonstrated robust methodology overall, but a more comprehensive approach to handling missing data would have strengthened the reliability of its findings.

In terms of results, studies (27) and (29) effectively aligned their findings with the research objectives. However, a more comprehensive discussion of missing data, confounder adjustments, and broader implications would enhance the holistic interpretation of the results.

DISCUSSION

This meta-analysis provides a detailed examination of the prevalence and risk factors associated with childhood obesity across urban and rural India. Findings reveal an average obesity prevalence of 9.0% in urban areas compared to 4.0% in rural settings, underscoring a significantly greater burden in urban environments. A notable gender disparity is observed, with male children showing higher prevalence rates in urban areas. Key risk factors identified include socioeconomic determinants like higher income and parental education, unhealthy lifestyle behaviours, and environmental factors such as increased access to junk food and sedentary lifestyles. These results highlight the need for targeted interventions, particularly in urban regions, to address childhood obesity.

The results of this meta-analysis have substantial implications for understanding the dynamics of childhood obesity in both urban and rural contexts, closely aligning with the study's primary objectives. The substantially higher prevalence of obesity in urban settings (9.0% versus 4.0% in rural areas) emphasizes the impact of urbanization on lifestyle and dietary patterns, highlighting the necessity for tailored interventions in urban areas (34,39). Although there is a slight gender-based difference, with boys showing a higher prevalence in urban areas, this variation lacks statistical significance. Gender disparities are even less pronounced in rural settings, suggesting that obesity affects children across gender lines and requires inclusive strategies for both boys and girls (31,33,38).

Socioeconomic and Environmental Risk Factors

Socioeconomic determinants, including higher income, parental education, and private school attendance, emerged as significant contributors to urban childhood obesity (33,38). This illustrates the complex relationship between socioeconomic status and childhood obesity, where increased access to resources can lead to both healthier choices and the adoption of unhealthy behaviours. Effective

interventions should address these socioeconomic nuances to curb urban childhood obesity.

Lifestyle and environmental factors also play a critical role. Unhealthy dietary habits, such as frequent junk food consumption, and sedentary behaviours, like excessive screen time, are significant risk factors in both urban and rural settings. The availability of unhealthy food in school environments and the influence of technology further underscore the need for comprehensive lifestyle-focused interventions (32,34,36,37,39). Public health policies should be based on empirical evidence and designed to promote healthier lifestyles, dietary improvement, and physical activity, especially in urban areas with higher obesity rates. Tailoring these interventions to the specific socioeconomic and gender dynamics in each region is essential for success (30,31,38).

Gender-Inclusive and Context-Specific Strategies

While gender differences in obesity prevalence were not statistically significant, they suggest a potential trend that should be addressed in designing interventions. Public health initiatives should aim for equitable engagement of both boys and girls, ensuring all children benefit from these programs (33,38).

This analysis underscores the urgency of a multifaceted approach to addressing childhood obesity in India, targeting urban-rural disparities, socioeconomic factors, and lifestyle influences. Collaboration among policymakers, healthcare providers, and community stakeholders is essential for creating evidence-based, context-specific interventions that effectively tackle childhood obesity.

Specific strategies include:

- Gender-sensitive interventions: Design programs that address the unique needs of boys and girls regarding obesity.
- Community-based initiatives: Promote healthy eating, physical activity, and supportive environments for children and families.
- School-based interventions: Incorporate nutrition and physical activity into school curricula and educate students on healthy eating.
- Healthcare provider education: Train providers to screen for childhood obesity, counsel on healthy lifestyles, and refer patients to resources.
- Policy interventions: Introduce policies that promote healthy eating and physical activity, such as restricting unhealthy food marketing to children and creating accessible spaces for exercise.
- Socioeconomic interventions: Address underlying socioeconomic factors, such as poverty and limited healthcare access, contributing to childhood obesity.

Through a comprehensive, multi-sectoral approach, India can address childhood obesity effectively and enhance the health and well-being of its younger population.

Future Research and Policy Recommendations

The outcomes of this meta-analysis highlight the importance of adopting longitudinal designs in future research to understand causal relationships and long-term trends in childhood obesity. Additionally, evaluating the effectiveness of interventions within the Indian context, given urban-rural disparities, is essential (34,39). This meta-analysis provides valuable insights into the multifaceted challenge of childhood obesity in India, equipping policymakers, healthcare

practitioners, and researchers with critical information to design targeted interventions that address the complexities faced by urban and rural populations alike.

These findings also add significant value to the existing literature on childhood obesity in India. The observed prevalence rates align with previous studies documenting rising obesity trends among Indian children (33,38). The higher urban prevalence mirrors global patterns linking urbanization to unhealthy lifestyle changes, reinforcing the need for targeted urban interventions (34). This aligns with global evidence showing urbanization's impact on dietary and activity levels (3). Moreover, the identification of socioeconomic factors as key contributors corroborates previous research emphasizing the complex interplay of income, education, and obesity (40-42). This reinforces the need to address socioeconomic determinants in intervention strategies.

Strengths and Limitations

This meta-analysis utilized rigorous methodology, including comprehensive literature searches, standardized data extraction, and quality assessment of included studies. The inclusion of diverse studies from various urban and rural areas in India strengthens the generalizability of these findings.

Nonetheless, certain limitations should be acknowledged. The relatively small number of studies that met inclusion criteria, along with variations in prevalence estimates, may limit the findings' generalizability. While the analysis provides valuable insights, caution should be exercised when applying results across all regions and populations within India.

Further research is necessary to validate and expand these findings, particularly in local contexts. Addressing data gaps, such as the limited number of studies in certain regions, will help provide a comprehensive understanding of childhood obesity in India.

Future research should focus on:

- Longitudinal studies: Track trends in childhood obesity prevalence and risk factors over time.
- Qualitative research: Explore the social, cultural, and environmental factors that contribute to childhood obesity.
- Cost-effectiveness analyses: Assess the economic impact of interventions aimed at reducing childhood obesity.

By addressing these limitations and conducting additional research, policymakers and healthcare providers can develop more effective and tailored interventions to combat childhood obesity in India.

CONCLUSION

This meta-analysis investigates the prevalence and contributing factors of childhood obesity across urban and rural India. The primary research goal was to assess the scope of childhood obesity in these areas and identify key risk factors behind this growing health issue. With childhood obesity rates rising sharply across India, there is an urgent need for evidence-based insights to shape public health policies and interventions.

Using a rigorous meta-analytical approach, this study critically examined 10 primary research studies conducted in India. The findings reveal a stark contrast in obesity prevalence, with higher rates observed in urban regions compared to rural areas. Factors driving this disparity include unhealthy dietary habits, low

physical activity, and socioeconomic influences. These findings highlight an urgent need for region-specific interventions that address the urban-rural gap in childhood obesity rates. Interventions should focus on promoting healthy lifestyles, improving access to nutritional education, and providing opportunities for physical activity, particularly in urban areas where obesity is more prevalent. Emphasizing lifestyle interventions that encourage healthier diets and increased physical activity is essential. Developing gender-inclusive programs that cater to both boys and girls is also critical. This meta-analysis emphasizes the need for more extensive research across diverse Indian settings to build stronger evidence base and support effective public health responses. In essence, this study illuminates the urgent issue of childhood obesity in India, underscoring the importance of targeted interventions, lifestyle changes, and gender-sensitive approaches to combat this expanding health crisis.

Future Research and Policy Directions

Future research should build on this study's insights to further our understanding of childhood obesity in India's urban and rural regions. Longitudinal studies are needed to trace obesity trends over time and evaluate long-term health impacts. Variations within urban and rural areas also require investigation, given India's diverse cultural, dietary, and socioeconomic backgrounds. In-depth studies on cultural and societal factors, including food preferences, family influences, and peer dynamics, are crucial for uncovering root causes. Assessing the effectiveness of various interventions—such as school-based programs, community initiatives, and policy reforms—will help inform evidence-based strategies. Further studies examining disparities in obesity rates and healthcare access among socioeconomic groups can aid in designing targeted interventions to reduce health

inequities. Qualitative research should explore psychosocial aspects and challenges to behavioural change. Addressing childhood obesity in India comprehensively requires a multidisciplinary approach, considering regional and cultural diversity, and fostering collaboration among researchers, healthcare providers, policymakers, and community stakeholders.

CONFLICTS OF INTEREST

FUNDING

ACKNOWLEDGMENT

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Supplemental Materials

Appendix 1: Quality Appraisal I

Study 1: The study of obesity among children aged 5-18 years in Jaipur, Rajasthan

	Item No	Recommendation	Yes/No/ Not clear	Page number	Comments
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Yes	125	Clearly mentioned
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Yes	125	Clearly mentioned
Introduction					
Background/ rationale	2	Explain the scientific background and rationale for the investigation being reported	Yes	125-126	Clearly mentioned
Objectives	3	State-specific objectives, including any prespecified hypotheses	Yes	125-126	Hypothesis not mentioned
Methods					
Study design	4	Present key elements of study design early in the paper	Yes	126	Clearly mentioned
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Yes	126	Dates not mentioned
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	Yes	126	Clearly mentioned

Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Yes	126	Outcomes defined and others were not applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Yes	126	No comparison is there
Bias	9	Describe any efforts to address potential sources of bias	Yes	126	Sampling randomly done
Study size	10	Explain how the study size was arrived at	Yes	126	Clearly mentioned
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Not clear	NA	NA
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Yes	127-129	Not about confounders
		(*b*) Describe any methods used to examine subgroups and interactions	Yes	127-129	Chi-square test
		(*c*) Explain how missing data were addressed	No	NA	Not mentioned
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Not clear	NA	NA
		(*e*) Describe any sensitivity analyses	No	NA	NA
Results					
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed	Yes	126	As per cross-sectional study

		eligible, included in the study, completing follow-up, and analysed			
		(b) Give reasons for non-participation at each stage	NA	NA	NA
		(c) Consider use of a flow diagram	NA	NA	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Yes	126-127	Not about exposure and confounders
		(b) Indicate number of participants with missing data for each variable of interest	NA	NA	No missing data
Outcome data	15*	Report numbers of outcome events or summary measures	Yes	127	Prevalence reported
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	NA	NA	NA
		(*b*) Report category boundaries when continuous variables were categorized	Yes	127	Age, income, are categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA	NA	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA	NA	NA
Discussion					
Key results	18	Summarise key results with reference to study objectives	Yes	128-130	Mentioned
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or	No	NA	Not mentioned

	Item No	Recommendation	Yes/No/ Not clear	Page number	Comments
		imprecision. Discuss both direction and magnitude of any potential bias			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Yes	128-130	Mentioned
Generalisability	21	Discuss the generalisability (external validity) of the study results	Yes	130	Implications provided
Other information					
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	NA	130	No funding

Study 2: Prevalence of obesity and overweight among school children of Pune city, Maharashtra, India: a cross-sectional study

	Item No	Recommendation	Yes/No/ Not clear	Page number	Comments
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Yes	3599	Clearly mentioned
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Yes	3599	Clearly mentioned
Introduction					
Background/ rationale	2	Explain the scientific background and rationale for the investigation being reported	Yes	3599- 3600	Clearly mentioned

Objectives	3	State-specific objectives, including any prespecified hypotheses	Yes	3599- 3600	Only objectives mentioned
Methods					
Study design	4	Present key elements of study design early in the paper	Yes	3600	Clearly mentioned
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Yes	3600	Applicable aspects mentioned
Participants	6	(*a*) Give the eligibility criteria and the sources and methods of selection of participants	Not clear	NA	Eligibility criteria not clear
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Yes	3600	Outcome measures were explained and others were not mentioned
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Yes	3600	No comparison is there
Bias	9	Describe any efforts to address potential sources of bias	Yes	3600	Random type sampling done
Study size	10	Explain how the study size was arrived at	Yes	3600	Clearly mentioned

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Yes	3600	mentioned	
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Not clear	NA	Not explained	
		(*b*) Describe any methods used to examine subgroups and interactions	Yes	3601-3602	Chi-square test	
		(*c*) Explain how missing data were addressed	NA	NA	NA	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Not clear	NA	NA	
		(*e*) Describe any sensitivity analyses	No	NA	NA	
Results						
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Yes	3600	Sample size mentioned	
		(b) Give reasons for non-participation at each stage	NA	NA	NA	
		(c) Consider use of a flow diagram	No	NA	NA	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Yes	3600	Mentioned except exposures and potential confounders	
		(b) Indicate number of participants with missing data for each variable of interest	NA	NA	NA	

Outcome data	15*	Report numbers of outcome events or summary measures	Yes	3601	Prevalence mentioned
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Not clear	NA	Chi-square results only mentioned
		(*b*) Report category boundaries when continuous variables were categorized	Not clear	NA	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA	NA	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA	NA	NA
Discussion					
Key results	18	Summarise key results with reference to study objectives	Yes	128-130	Mentioned
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	No	NA	Not mentioned
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Yes	128-130	Mentioned
Generalisability	21	Discuss the generalisability (external validity) of the study results	Yes	130	Implications provided
Other information					
Funding	22	Give the source of funding and the role of the funders for the present study and, if	NA	130	No funding

		applicable, for the original study on which the present article is based			

Study 3: Prevalence of obesity among adolescent school children in rural and urban south Odisha

	Item No	Recommendation	Yes/No/ Not clear	Page number	Comments
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Yes	261	Clearly mentioned
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Yes	261	Clearly mentioned
Introduction					
Background/ rationale	2	Explain the scientific background and rationale for the investigation being reported	Yes	261-262	Clearly mentioned
Objectives	3	State-specific objectives, including any prespecified hypotheses	Yes	262	Only objectives mentioned
Methods					
Study design	4	Present key elements of study design early in the paper	Yes	262	Clearly mentioned
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Yes	262	Applicable aspects mentioned

Participants	6	(*a*) Give the eligibility criteria and the sources and methods of selection of participants	Not clear	NA	Eligibility criteria not clear
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Not clear	NA	Only outcome measures were explained
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Yes	262	Mentioned
Bias	9	Describe any efforts to address potential sources of bias	Yes	262	Random sampling done
Study size	10	Explain how the study size was arrived at	Yes	262	Clearly mentioned
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Yes	262	Mentioned about coding
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Yes	262	Not about confounders
		(*b*) Describe any methods used to examine subgroups and interactions	Yes	262	Chi-square test
		(*c*) Explain how missing data were addressed	NA	NA	Not mentioned
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Not clear	NA	NA

		(*e*) Describe any sensitivity analyses	No	NA	NA
Results					
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Yes	262	As per the cross-sectional study
		(b) Give reasons for non-participation at each stage	NA	NA	NA
		(c) Consider use of a flow diagram	No	NA	No diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Yes	262-263	No information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest	NA	NA	NA
Outcome data	15*	Report numbers of outcome events or summary measures	Yes	263	Prevalence mentioned
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	No	NA	NA
		(*b*) Report category boundaries when continuous variables were categorized	Yes	263-264	mentioned
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA	NA	NA

Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA	NA	NA
Discussion					
Key results	18	Summarise key results with reference to study objectives	Yes	264-265	Mentioned
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Yes	264-265	Mentioned
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Yes	264-265	Mentioned
Generalisability	21	Discuss the generalisability (external validity) of the study results	Yes	265	Implications provided
Other information					
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	NA	NA	No funding

Study 4: Behavioural Determinants for Obesity: A Cross-sectional Study Among Urban Adolescents in India					
	Item No	**Recommendation**	**Yes/No/ Not clear**	**Page number**	**Comments**
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Yes	192	Clearly mentioned

		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Yes	192	Clearly mentioned
Introduction					
Background/ rationale	2	Explain the scientific background and rationale for the investigation being reported	Yes	192-193	Clearly mentioned
Objectives	3	State-specific objectives, including any prespecified hypotheses	Yes	193	Only objectives mentioned
Methods					
Study design	4	Present key elements of study design early in the paper	Yes	193	Clearly mentioned
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Yes	193	Applicable aspects mentioned
Participants	6	(*a*) Give the eligibility criteria and the sources and methods of selection of participants	Not clear	NA	Method of selection mentioned
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Yes (only outcome)	194	Outcome measures were explained and others were not applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of	Yes	193-194	Mentioned

		assessment methods if there is more than one group				
Bias	9	Describe any efforts to address potential sources of bias	Yes	193	Random sampling done	
Study size	10	Explain how the study size was arrived at	Yes	193	Clearly mentioned	
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Yes	194	Grouping based on tools	
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Yes	194	Mentioned	
		(*b*) Describe any methods used to examine subgroups and interactions	Yes	194	Chi-square test, multivariate analysis	
		(*c*) Explain how missing data were addressed	NA	NA	Not mentioned	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Not clear	NA	NA	
		(*e*) Describe any sensitivity analyses	No	NA	NA	
Results						
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Yes	193	As per the cross-sectional study	

		(b) Give reasons for non-participation at each stage	Yes	194	Some not provide consent
		(c) Consider use of a flow diagram	No	NA	No diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Yes	194	No information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest	NA	NA	NA
Outcome data	15*	Report numbers of outcome events or summary measures	Yes	196	Prevalence mentioned
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Yes	196	Logistic regression
		(*b*) Report category boundaries when continuous variables were categorized	Yes	195	mentioned
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA	NA	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA	NA	NA
Discussion					
Key results	18	Summarise key results with reference to study objectives	Yes	196	Mentioned
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or	Yes	198	Mentioned

		imprecision. Discuss both direction and magnitude of any potential bias			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Yes	196-198	Mentioned
Generalisability	21	Discuss the generalisability (external validity) of the study results	Yes	198	Implications provided
Other information					
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Yes	198	Just funding only mentioned

Study 5: Prevalence of obesity among urban and rural school going adolescents of Vadodara, India: a comparative study

	Item No	Recommendation	Yes/No/ Not clear	Page number	Comments
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Yes	1355	Clearly mentioned
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Yes	1355	Clearly mentioned
Introduction					
Background/ rationale	2	Explain the scientific background and rationale for the investigation being reported	Yes	1355-1356	Clearly mentioned
Objectives	3	State-specific objectives, including any prespecified hypotheses	Yes	1356	Only purpose mentioned

Methods					
Study design	4	Present key elements of study design early in the paper	Yes	1356	Clearly mentioned
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Yes	1356	Applicable contents mentioned
Participants	6	(*a*) Give the eligibility criteria and the sources and methods of selection of participants	Not clear	NA	Method of selection mentioned
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Yes (only outcome)	1356	BMI were explained and others were not applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Yes	1356	Mentioned
Bias	9	Describe any efforts to address potential sources of bias	No	NA	NA
Study size	10	Explain how the study size was arrived at	No	NA	NA
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Yes	1356	Mentioned
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Yes	1356	Mentioned

		(*b*) Describe any methods used to examine subgroups and interactions	Yes	1356	Different tests done
		(*c*) Explain how missing data were addressed	NA	NA	Not mentioned
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Not clear	NA	NA
		(*e*) Describe any sensitivity analyses	No	NA	NA
Results					
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Yes	1356	As per the cross-sectional study
		(b) Give reasons for non-participation at each stage	Yes	1356	Mentioned about incomplete data of some children
		(c) Consider use of a flow diagram	No	NA	No diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Yes	1356	No information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest	Yes	1356	36 data record sheets were incomplete
Outcome data	15*	Report numbers of outcome events or summary measures	Yes	1357	Prevalence mentioned
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence	Not clear	NA	NA

		interval). Make clear which confounders were adjusted for and why they were included			
		(*b*) Report category boundaries when continuous variables were categorized	Yes	1356	mentioned
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA	NA	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Yes	1356	Some analysis done
Discussion					
Key results	18	Summarise key results with reference to study objectives	Yes	1357	Mentioned
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Yes	1358	Mentioned
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Yes	1357-1358	Mentioned
Generalisability	21	Discuss the generalisability (external validity) of the study results	Not clear	NA	NA
Other information					
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Yes	1358	No funding

Study 6: A cross-sectional study on the Prevalence of overweight and obesity among school children of 6-12 years age in a rural area in Trichy district, Tamil Nadu

	Item No	Recommendation	Yes/No/ Not clear	Page number	Comments
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Yes	210	Clearly mentioned
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Yes	210	Clearly mentioned
Introduction					
Background/ rationale	2	Explain the scientific background and rationale for the investigation being reported	Yes	210	Clearly mentioned
Objectives	3	State-specific objectives, including any prespecified hypotheses	Yes	210	Only aim mentioned
Methods					
Study design	4	Present key elements of study design early in the paper	Yes	211	Clearly mentioned
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Yes	211	Applicable contents mentioned
Participants	6	(*a*) Give the eligibility criteria and the sources and methods of selection of participants	Yes	211	Mentioned

Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Yes (only outcome)	211	BMI was explained and others were not applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Yes	211	Mentioned
Bias	9	Describe any efforts to address potential sources of bias	No	NA	NA
Study size	10	Explain how the study size was arrived at	No	NA	NA
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Yes	211	Grouping not clear
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Yes	211	No mention on control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions	Yes	212	Chi square
		(*c*) Explain how missing data were addressed	NA	NA	Not mentioned
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Not clear	NA	NA
		(*e*) Describe any sensitivity analyses	No	NA	NA
Results					
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed	Yes	211	Sample size mentioned

		eligible, included in the study, completing follow-up, and analysed			
		(b) Give reasons for non-participation at each stage	NA	NA	NA
		(c) Consider use of a flow diagram	No	NA	No diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Yes	211	No information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest	NA	NA	NA
Outcome data	15*	Report numbers of outcome events or summary measures	Yes	211	Prevalence mentioned
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	No	NA	NA
		(*b*) Report category boundaries when continuous variables were categorized	Yes	212	mentioned
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA	NA	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA	NA	NA
Discussion					
Key results	18	Summarise key results with reference to study objectives	Yes	213	Mentioned

Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Yes	213	Mentioned
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Yes	213	Mentioned
Generalisability	21	Discuss the generalisability (external validity) of the study results	Not clear	NA	NA
Other information					
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	No	213	No funding

Study 7: Prevalence of overweight and obesity among rural adolescent school students in Kanchipuram district, Tamil Nadu					
	Item No	**Recommendation**	**Yes/No/ Not clear**	**Page number**	**Comments**
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Yes	173	Clearly mentioned
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Yes	173	Clearly mentioned
Introduction					
Background/ rationale	2	Explain the scientific background and rationale for the investigation being reported	Yes	173	Clearly mentioned

Objectives	3	State-specific objectives, including any prespecified hypotheses	Yes	173	Not specified it as objectives, just mentioned
Methods					
Study design	4	Present key elements of study design early in the paper	Yes	173	In abstract only
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Yes	174	Not all applicable
Participants	6	(*a*) Give the eligibility criteria and the sources and methods of selection of participants	Not clear	NA	Not clear. But mentioned few points
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Yes (only outcome)	174	BMI were explained and others were not applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Not clear	NA	Not clear
Bias	9	Describe any efforts to address potential sources of bias	Yes	174	Simple random technique used for sampling
Study size	10	Explain how the study size was arrived at	Yes	174	Mentioned

			Yes	174	Grouping not clear
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Yes	174	Grouping not clear
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	No	NA	NA
		(*b*) Describe any methods used to examine subgroups and interactions	No	NA	NA
		(*c*) Explain how missing data were addressed	NA	NA	Not mentioned
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Not clear	NA	NA
		(*e*) Describe any sensitivity analyses	No	NA	NA
Results					
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Yes	174	Sample size mentioned
		(b) Give reasons for non-participation at each stage	NA	NA	NA
		(c) Consider use of a flow diagram	No	NA	No diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Yes	174-175	No information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest	NA	NA	NA

Outcome data	15*	Report numbers of outcome events or summary measures	Yes	175	Prevalence mentioned
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	No	NA	NA
		(*b*) Report category boundaries when continuous variables were categorized	Not clear	NA	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA	NA	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA	NA	NA
Discussion					
Key results	18	Summarise key results with reference to study objectives	Yes	175	Mentioned
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Yes	175	Mentioned
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Yes	175	Mentioned
Generalisability	21	Discuss the generalisability (external validity) of the study results	Yes	175	implications
Other information					
Funding	22	Give the source of funding and the role of the funders for the present study and, if	No	175	No funding

		applicable, for the original study on which the present article is based			

Study 8: Prevalence of overweight and obesity among children aged 5-15 years in a rural school in Coimbatore

	Item No	Recommendation	Yes/No/ Not clear	Page number	Comments
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Yes	2186	Clearly mentioned
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Yes	2186	Clearly mentioned
Introduction					
Background/ rationale	2	Explain the scientific background and rationale for the investigation being reported	Yes	2186-2187	Clearly mentioned
Objectives	3	State-specific objectives, including any prespecified hypotheses	Yes	2186-2187	Not specified about hypothesis
Methods					
Study design	4	Present key elements of study design early in the paper	Yes	2187	mentioned
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Yes	2187	Not all applicable

Participants	6	(*a*) Give the eligibility criteria and the sources and methods of selection of participants	Not clear	NA	Not clear.
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Yes (only outcome)	2187	BMI were explained and others were not applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Yes	2187	Mentioned
Bias	9	Describe any efforts to address potential sources of bias	No	NA	No mention
Study size	10	Explain how the study size was arrived at	No	NA	No mention
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Yes	2187	Grouping not clear
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	No	NA	NA
		(*b*) Describe any methods used to examine subgroups and interactions	No	NA	NA
		(*c*) Explain how missing data were addressed	NA	NA	Not mentioned
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Not clear	NA	NA

			No	NA	NA
Results					
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Yes	2187	Sample size mentioned
		(b) Give reasons for non-participation at each stage	NA	NA	NA
		(c) Consider use of a flow diagram	No	NA	No diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Yes	2187	No information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest	NA	NA	NA
Outcome data	15*	Report numbers of outcome events or summary measures	Yes	2187	Prevalence mentioned
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	No	NA	NA
		(*b*) Report category boundaries when continuous variables were categorized	Not clear	NA	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA	NA	NA

(*e*) Describe any sensitivity analyses — No | NA | NA

Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA	NA	NA
Discussion					
Key results	18	Summarise key results with reference to study objectives	Yes	2187	Mentioned
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Yes	2187	Mentioned
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Yes	2187-2188	Mentioned
Generalisability	21	Discuss the generalisability (external validity) of the study results	Yes	2188	implications
Other information					
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	No	2189	No funding

Study 9: Study on prevalence of overweight and obesity amongst school children of Bangalore

	Item No	Recommendation	Yes/No/ Not clear	Page number	Comments
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Yes	159	Clearly mentioned

			(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Yes	159	Clearly mentioned
Introduction						
Background/ rationale	2		Explain the scientific background and rationale for the investigation being reported	Yes	159-160	Clearly mentioned
Objectives	3		State-specific objectives, including any prespecified hypotheses	Yes	160	Not specified about hypothesis
Methods						
Study design	4		Present key elements of study design early in the paper	Yes	160	Mentioned
Setting	5		Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Yes	160	Mentioned applicable aspects
Participants	6		(*a*) Give the eligibility criteria and the sources and methods of selection of participants	Yes	160	Not clear. But mentioned
Variables	7		Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Yes (only outcome)	160	Outcomes defined
Data sources/ measurement	8*		For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Yes	160-162	Mentioned

Bias	9	Describe any efforts to address potential sources of bias	No	NA	No mention
Study size	10	Explain how the study size was arrived at	No	NA	No mention
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Yes	160	Grouping not clear
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	No	NA	NA
		(*b*) Describe any methods used to examine subgroups and interactions	No	NA	NA
		(*c*) Explain how missing data were addressed	NA	NA	Not mentioned
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Not clear	NA	NA
		(*e*) Describe any sensitivity analyses	No	NA	NA
Results					
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Yes	161	Sample size mentioned
		(b) Give reasons for non-participation at each stage	NA	NA	NA
		(c) Consider use of a flow diagram	No	NA	No diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Yes	161	No information on exposures and potential confounders

		(b) Indicate number of participants with missing data for each variable of interest	NA	NA	NA
Outcome data	15*	Report numbers of outcome events or summary measures	Yes	161	Prevalence mentioned
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	No	NA	NA
		(*b*) Report category boundaries when continuous variables were categorized	Yes	161	Mentioned
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA	NA	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA	NA	NA
Discussion					
Key results	18	Summarise key results with reference to study objectives	Yes	162-163	Mentioned
Limitations	19	Discuss the limitations of the study, taking into account sources of potential bias or imprecision. Discuss both the direction and magnitude of any potential bias	No	NA	NA
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Yes	161-162	Mentioned
Generalisability	21	Discuss the generalisability (external validity) of the study results	Yes	162-163	Implications
Other information					

	Item No	Recommendation			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	No	163	No funding

Study 10: A cross-sectional study on the prevalence of overweight and obesity in affluent school children of central Kerala

	Item No	Recommendation	Yes/No/ Not clear	Page number	Comments
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Yes	4284	Clearly mentioned
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Yes	4284	Clearly mentioned
Introduction					
Background/ rationale	2	Explain the scientific background and rationale for the investigation being reported	Yes	4284-4285	Clearly mentioned
Objectives	3	State-specific objectives, including any prespecified hypotheses	Yes	4284 and 4285	Not specified about hypothesis
Methods					
Study design	4	Present key elements of study design early in the paper	Yes	4285	Mentioned
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Yes	4285	Mentioned applicable details

Participants	6	(*a*) Give the eligibility criteria and the sources and methods of selection of participants	Yes	4285	Not fully mentioned
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Not clear	4285	Outcome variables measurement mentioned
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Yes	4285	Mentioned
Bias	9	Describe any efforts to address potential sources of bias	Yes	4285	Sampling; universal
Study size	10	Explain how the study size was arrived at	No	4285	Mentioned
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Yes	4285	Grouping not mentioned clearly
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Yes	4285	Not mentioned about confounding
		(*b*) Describe any methods used to examine subgroups and interactions	Yes	4286	Chi-square done
		(*c*) Explain how missing data were addressed	NA	NA	Not mentioned
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Not clear	NA	NA
		(*e*) Describe any sensitivity analyses	No	NA	NA

Results

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Yes	4285	Sample size mentioned
		(b) Give reasons for non-participation at each stage	NA	NA	NA
		(c) Consider use of a flow diagram	No	NA	No diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Yes	4285	No information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest	NA	NA	NA
Outcome data	15*	Report numbers of outcome events or summary measures	Yes	4285	Prevalence mentioned
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	No	NA	NA
		(*b*) Report category boundaries when continuous variables were categorized	Not clear	NA	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA	NA	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Not clear	NA	NA

Discussion

Key results	18	Summarise key results with reference to study objectives	Yes	4286	Mentioned
Limitations	19	Discuss the limitations of the study, considering sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	No	4286	NA
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Yes	4286	Mentioned
Generalisability	21	Discuss the generalisability (external validity) of the study results	Yes	4286-4287	Implications
Other information					
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	No	4287	No funding

Appendix 2: Data Extraction Table

Childhood Obesity in Urban and Rural India: A Systematic Review and Meta-Analyses of Prevalence Studies								
Authors/year	Aim/objectives	Study design	Study setting	Urban/ rural area	Sample size	Sampling	Study population (age group)	Data collection details
(Jain et al., 2016)	To study the obesity among children of aged 5-18 years in Jaipur, Rajasthan.	Cross sectional study	Jaipur, Rajasthan	Urban	1000	Simple random sampling	Children (5-18 years)	Semi-structured questionnaire, (BMI) was calculated

(Ghonge et al., 2015)	To find out prevalence of obesity and overweight among school children.	Cross sectional study	Pune, Maharashtra	Urban	1281	Random sampling	Children (10 and 15 years)	Pre-designed, pre-tested, semi-structured performa, BMI were calculated
(Pradhan et al., 2022)	Estimating the prevalence of obesity among rural and urban adolescent school children and to assess the risk factors associated with adolescent obesity.	Cross sectional study	Ganjam, Odisha	Urban and Rural	180	Systematic random sampling	Adolescents (high school)	Pre-designed and pre-tested questionnaire, (BMI) was calculated
(Rani and Sathiyasekaran, 2013)	To address the prevalence of behavioural risk factors for obesity among randomly selected urban adolescent students from both private and government schools in Chennai, Tamil Nadu.	Cross sectional study	Chennai, Tamil Nadu	Urban	1842	Simple random sampling	Adolescents (12-18 years)	Age-appropriate modified GSHS self-administered questionnaire, standardized International Physical Activity Questionnaire (short form),(BMI) was calculated

(Pathak et al., 2018)	To compare the prevalence of obesity among urban and rural school going children of adolescent age in district of Vadodara and also to study various predisposing factors.	Cross sectional study	Vadodara, Gujarat	Urban and Rural	188	No details	School going children of adolescent age group (10 to 18 years of age)	(BMI) was calculated, standardized questionnaire
(Vidhya et al., 2023)	To assess the prevalence of obesity among rural school children of 6-12 years of age and to determine factors associated with obesity	Cross sectional study	Trichy district, Tamil Nadu	Rural	100	Multistage cluster sampling	Children aged 6-12 years	(BMI) was calculated, Semi structured questionnaire.
(Danasekaran and Ranganathan, 2	To assess the prevalence of overweight and obesity among the school in the age group of 14-17 years in Kanchipuram district of Tamil Nadu.	Cross sectional study	Kanchipuram, Tamil Nadu	Rural	934	Simple random sampling	Children aged 14-17 years	(BMI) was calculated, questionnaire
(Shanmugam et al., 2016)	To study the prevalence of overweight and obesity among school children in a rural school in Coimbatore using the WHO standard reference for age 5–19 years.	Cross sectional study	Coimbatore, Tamil Nadu	Rural	890	No details	School children aged 5–15 years	(BMI) was calculated, questionnaire

| (Kumar et al., 2019) | To assess the prevalence of overweight and obesity amongst school children of Bangalore and to study the association of age and gender with overweight and obesity amongst school children of Bangalore. | Cross sectional study | Bangalore, Karnataka | Rural | 1127 | No details | School children aged 6 to 16 years | (BMI) was calculated BMI charts based on NCHS (National Centre for Health Statistics), CDC USA (United States of America) standards, questionnaire |
| (Viswambharan and Abraham, 2021) | To assess the prevalence of obesity among affluent school children in Thrissur | Cross sectional study | Thrissur, Kerala | Urban | 1104 | Universal sampling method | Private school children (4 and 18 years) | Semi-structured questionnaire, BMI was calculated |

Appendix 3: Quality Appraisal II

Childhood Obesity in Urban and Rural India: A Systematic Review and Meta-Analyses of Prevalence Studies									
Authors/year	Analysis details	Ethics information	Funding information	Conflict of interest present or not	Total prevalence	Rural prevalence	Urban prevalence	Gender based prevalence	Risk factors
(Jain et al., 2016)	**Software:** No details **Methods:** Descriptives, Chi-square test	**Consent attained:** Yes **IRB approval**	No funding	No	5.60 %	NA	5.60 %	**Male:** 17.9 % **Female:**	Less physical activity, High-income family, Male gender, Junk food,

	attained: No details							15.9 %	chocolate, and eating outside the home, more nonvegetarian diet, lesser physical activity
(Ghonge et al., 2015)	**Software:** Microsoft Excel and Open- Epi Software (Version 2.3). **Methods:** Descriptives, Chi-square test	**Consent attained:** Yes **IRB approval attained:** Yes	No funding	No	5.62 %	NA	5.62 %	**Male:** 4.62 % **Female:** 6.8%	Age groups (15 years age group both in Government schools and private schools), children of Private schools have higher prevalence
(Pradhan et al., 2022)	**Software:** SPSS ver.16.0 **Methods:** Proportions, chi-square test, mean, and standard deviations, unpaired t-test	**Consent attained:** Yes **IRB approval attained:** Yes	No funding	No	5.00 %	3.33 %	6.66 %	More in males	Urban school students, older students, hours of television and/or smartphone and laptop use, Consumption of carbonated drinks, and irregular breakfast, Tiffin from canteen, physical activities like outdoor games and mode of conveyance to school

(Rani and Sathiyasekaran, 2013)	**Software:** SPSS ver 15.0 **Methods:** Descriptives, Pearson's chi-squared test, logistic regression models	**Consent attained:** Yes **IRB approval attained:** Yes	Ramacha ndra Universit y	No	5.20 %	NA	5.20 %	More in femal es	Younger age group, female sex, a high level of father's and mother's education, and the type of school they were attending, type of school, and fast-food consumption, private schools,
(Pathak et al., 2018)	**Software:** SPSS ver 23 **Methods:** Descriptives, Independent sample test (Kruskal-Wallis test), Spearman's rho, Odds ratio, Mann-Whitney U test, chi-square test	**Consent attained:** Yes **IRB approval attained:** Yes	No funding	No	17.60 %	2.20 %	31.30 %	**Male:** 20.2 % **Fema le:** 15.4 %	Higher parental Annual income, frequency of restaurant and school canteen food consumption and lesser frequency of physical training sessions conducted in schools.
(Vidhya et al., 2023)	**Software:** SPSS **Methods:** Descriptives, Chi-square test	**Consent attained:** No details **IRB approval attained:** Yes	No funding	No	6.00 %	6.00 %	NA	**Male:** 4.0% **Fema le:** 2.0%	Number of family members
(Danasekaran and Ranganathan, 2	**Software:** SPSS **Methods:** Descriptives	**Consent attained:** Yes **IRB approval attained:** Yes	No funding	No	4.40 %	4.40 %	NA	**Male:** 4.58 % **Fema le:** 4.20 %	Not covered

(Shanmugam et al., 2016)	**Software:** SPSS ver 19 **Methods:** Descriptives, Chi-square tests	**Consent attained:** Yes **IRB approval attained:** Yes	No funding	No	4.72 %	4.72 %	NA	**Male:** 6.43 % **Female:** 2.96 %	No significant findings
(Kumar et al., 2019)	**Software:** SPSS ver 24 **Methods:** Descriptives, Chi-square tests	**Consent attained:** Yes **IRB approval attained:** Yes	No funding	No	4.08 %.	4.08 %.	NA	**Male:** 2.04 %. **Female:** 2.04 %.	No significant findings
(Viswambharan and Abraham, 2021)	**Software:** SPSS ver 20 **Methods** Proportions, means and standard deviations, Bivariate analysis	**Consent attained:** Yes **IRB approval attained:** Yes	No funding	No	7.30 %	NA	7.30 %	**Male:** 8.3% **Female:** 5.9%	Increase in age and male gender