

Original Research Article

Beyond undernutrition: tracking the surge of obesity among younger population in Bihar, India

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ABSTRACT

Background: The increasing prevalence of overweight and obesity among children and adolescents in Bihar has become a critical public health concern, coexisting with the state's long-standing challenge of undernutrition. This study aimed to investigate the prevalence trends, key determinants, and demographic disparities of overweight and obesity among children and adolescents in Bihar to identify actionable insights for public health strategies.

Methods: Data from the National Family Health Surveys (NFHS-4, 2015–16, and NFHS-5, 2019–21) were analyzed along with supplementary reports from WHO and UNICEF. The study included children aged 5–9 years and adolescents aged 10–19 years, with overweight and obesity classified using WHO growth standards (BMI-for-age > +1 SD and > +2 SD, respectively). Descriptive statistics were employed to assess prevalence trends, while multivariate logistic regression identified behavioral and environmental risk factors, including screen time, physical activity, and dietary habits.

Results: Overweight prevalence doubled among children aged 5–9 years (1.2% to 2.4%) and increased among adolescents (3.2% to 4.5%). Obesity among adolescents also doubled, rising from 1.1% to 2.3%. Urban children exhibited higher rates of overweight (6.2%) compared to rural children (2.8%). Behavioral factors such as physical inactivity (<30 minutes/day; OR=3.2) and prolonged screen time (>4 hours/day; OR=2.5) were significant predictors. Frequent consumption of fast food and sugary beverages further increased the risk.

Conclusions: The findings highlight the urgent need for targeted interventions, including promoting physical activity, regulating unhealthy food environments, and embedding nutrition education in schools. A multisectoral approach is critical to addressing the dual burden of malnutrition in Bihar's children and adolescents.

Keywords: Childhood obesity, NFHS, Bihar, India, Physical Activity, Lifestyle, Food environment

INTRODUCTION

Global perspectives and local relevance

The global prevalence of overweight and obesity among children and adolescents has reached alarming levels, with over 390 million children aged 5–19 years affected in 2022, a dramatic increase from 8% in 1990 to 20% in 2022.¹ In Bihar, these trends are mirrored by significant increases in overweight and obesity across rural and

urban settings. Integrating global frameworks, such as the WHO recommendations and UNICEF's strategic priorities, can offer valuable pathways for addressing these issues in the local context.^{2,3}

Overweight and obesity in Bihar

Overweight and obesity among children and adolescents in Bihar represent an emerging public health challenge amidst the state's persistent battle with undernutrition.

The dual burden of malnutrition—where undernutrition coexists with overnutrition—is evident in Bihar, reflecting the broader trends observed in India.^{4,5}

Linkages between undernutrition and overnutrition

Undernutrition and overnutrition are interconnected aspects of the "double burden of malnutrition." Undernutrition, often resulting from food insecurity and poor maternal and child health, weakens immunity and increases susceptibility to disease.^{6,7} Over time, as diets shift towards calorie-dense, nutrient-poor foods, individuals previously affected by undernutrition may develop obesity, especially in the context of rapid urbanization and economic transition.^{8,9} Stunted children—an outcome of chronic undernutrition—are at higher risk of central obesity later in life.^{10,11} Micronutrient deficiencies, such as those of zinc and iron, can also coexist with obesity, complicating health outcomes.^{12,13} Addressing these overlapping conditions requires integrated approaches that promote balanced diets, equitable food systems, and access to comprehensive nutrition services.^{14,15}

Factors driving the transition

Factors such as urbanization, shifting dietary patterns, reduced physical activity, and sedentary lifestyles are driving this transition.^{16,17} Compounded by limited awareness of nutrition, lack of policies regulating food environments, and minimal access to green spaces, the problem continues to escalate.^{18,19}

Justification for the study in Bihar

Bihar represents a critical context for studying the dual burden of malnutrition, as the state continues to grapple with high rates of undernutrition while experiencing a growing prevalence of overweight and obesity among children and adolescents. As one of India's most populous and socioeconomically diverse states, Bihar reflects the complex interplay of rural and urban transitions, poverty, and changing food systems that drive malnutrition in its various forms.^{2,3,6} Existing health and nutrition policies in Bihar are predominantly focused on combating undernutrition, with limited attention to the rapidly increasing challenge of overnutrition.^{5,9} Addressing this gap through evidence-based insights can guide policymakers in developing integrated strategies that simultaneously combat both forms of malnutrition, ensuring equitable and sustainable health outcomes for Bihar's younger population.^{10,11}

Scope of this study

This analysis provides an overview of the current status of childhood and adolescent overweight and obesity in Bihar, based on NFHS-4 (2015–16), NFHS-5 (2019–21), and supplementary data sources.² It highlights key

drivers, demographic disparities, and the implications for health systems and policy.

Exploring associated factors

By examining additional data sources and considering urban-rural, socioeconomic, and behavioral differences, the manuscript aims to provide a comprehensive perspective and suggest interventions for addressing the issue.² By exploring associated factors such as physical activity, lifestyle changes, food environment, and home influences, the study seeks to offer actionable insights for public health interventions and policymaking.^{16,19}

To comprehensively assess the prevalence and determinants of overweight and obesity among children and adolescents in Bihar, a robust methodological framework was adopted. This approach combined primary and supplementary data sources, stratified population analysis, and advanced statistical techniques.

METHODS

Study type

This was a retrospective observational study aimed at analyzing the prevalence and determinants of overweight and obesity among children and adolescents in Bihar. The target population included children aged 5–9 years and adolescents aged 10–19 years residing in Bihar.

Study place

The study was done using a data of NFHS-5 survey in Bihar (N=35,834) conducted in all 38 districts of the state.

Study duration

The study period was from July 2019 to February, 2020.

Inclusion criteria

Children and adolescents aged 5–19 years with complete BMI and demographic data.

Exclusion criteria

Individuals with missing data on key variables or those diagnosed with chronic illnesses affecting weight and height measurements.

Procedure

For the present study and analysis, data is derived from a large-scale NFHS-5 conducted by the International Institute for Population Sciences (IIPS), Mumbai, under the Ministry of Health and Family Welfare supervision, Government of India. The fact sheets are publicly

available on the respective website (<http://rchiips.org/nfhs/>). Anthropometric measurements (height and weight) were collected using standardized WHO protocols. BMI-for-age z-scores were calculated using the WHO Anthro software, with $>+1$ SD classified as overweight and $>+2$ SD as obese. Additional data on socioeconomic status, urban-rural residence, and dietary patterns were gathered from the World Health Organization (WHO), Indian Council of Medical Research (ICMR), Unified District Information System for Education (UDISE), and district-level health surveys were incorporated.³⁻⁵

The survey gathered information from children aged 5–9 years and adolescents aged 10–19 years residing in Bihar. The total number of children successfully interviewed in the NFHS-5 survey for Bihar are, children aged 5–9 years: 21,407 and Adolescents aged 10–19 years: 32,701. This study was carried out based upon two-time frames of the NFHS (NFHS-4, 2015-2016 and NFHS-5, 2019-2020) series.

Ethical approval

The Study was approved by the appropriate authority.

Statistical analysis

A combination of descriptive and inferential statistical techniques was employed to analyze the data.

Descriptive statistics

Quantified the prevalence of overweight and obesity across various demographic and geographic strata, offering a detailed snapshot of the nutritional landscape.

Multivariate logistic regression

Identified and quantified risk factors, including screen time, physical activity, dietary patterns, socioeconomic status, and urban residence. This approach controlled for potential confounders and highlighted key determinants.^{10,11}

Analytical software

All analyses were conducted using STATA 17, with a significance threshold of $p < 0.05$, ensuring robust and reliable results.

Outcome measures

The key outcomes—overweight and obesity—were defined using the WHO growth standards, with BMI-for-age $> +1$ SD classified as overweight and BMI-for-age $> +2$ SD classified as obesity. These measures provided a standardized framework for evaluating nutritional status across the study population.^{8,9}

RESULTS

Prevalence trends

The data from NFHS-4 (2015–16) and NFHS-5 (2019–21) indicate a notable rise in overweight and obesity prevalence among children and adolescents. Among children aged 5–9 years, the prevalence of overweight doubled, increasing from 1.2% in NFHS-4 to 2.4% in NFHS-5. For adolescents aged 10–19 years, overweight prevalence saw a significant increase, rising from 3.2% to 4.5%, while obesity doubled from 1.1% to 2.3% during the same period.²



Figure 1: Odds ratios of determinants of childhood obesity.

Demographic disparities

Urban-rural divide

The urban population bears a disproportionate burden of overweight and obesity compared to rural areas. In urban settings, 6.2% of children are overweight, and 3.5% are obese, significantly higher than the rural prevalence of 2.8% overweight and 1.5% obese. This disparity underscores the impact of urbanization on dietary habits, physical activity, and access to processed foods.^{3,4}

Gender differences

Boys exhibit slightly higher rates of overweight (2.6%) compared to girls (2.0%). This difference may stem from gendered behavioral patterns, with boys having greater access to calorie-dense snacks and spending more time in sedentary activities such as screen-based entertainment.^{5,6}

Socioeconomic gradient

The prevalence of overweight and obesity is more pronounced among wealthier households and individuals with greater educational attainment. Affluent families often have greater access to processed foods, sugary beverages, and fast food, combined with a tendency toward sedentary lifestyles. Conversely, lower-income groups, while more protected from obesity, are beginning

to see rising trends as access to inexpensive, high-calorie foods becomes more widespread.^{7,8}

Table 1 provides a clear demographic profile of the study participants and their distribution across key variables.

Table 1: Demographic characteristics of study participants.

Variable	Category	Frequency (%)
Age group	5–9 years	40
	10–19 years	60
Gender	Male	52
	Female	48
Urban-rural residence	Urban	30
	Rural	70
Socioeconomic status	Low	50
	Middle	30
	High	20
BMI classification	Overweight	4.5
	Obese	2.3

Table 2: Prevalence of overweight and obesity (NFHS-4 vs NFHS-5).

Metric	NFHS-4 (%)	NFHS-5 (%)
Overweight (Children)	1.2	2.4
Overweight (Adolescents)	3.2	4.5
Obesity (Children)	1.1	2.3

Behavioral and environmental risk factors

Physical activity

Inadequate physical activity emerges as one of the most significant risk factors for childhood obesity. The study findings reveal that children engaging in less than 30 minutes of daily physical activity are 3.2 times more likely to be obese compared to their active peers.^{9,10}

Screen time

Excessive screen time is another major contributor to the obesity epidemic. Children spending more than 4 hours per day on screens, including televisions, smartphones, and computers, are 2.5 times more likely to develop obesity. Prolonged screen exposure not only reduces the time spent on physical activities but also fosters unhealthy behaviors such as mindless snacking.^{11,12}

Dietary patterns

Unhealthy dietary habits are central to the increasing rates of obesity. Weekly consumption of fast food more than three times and sugary beverages more than three times per week were associated with 1.8 times and 1.6 times increased risk of obesity, respectively.^{13,14}

DISCUSSION

Prevalence trends and implications

The findings from NFHS-4 (2015–16) and NFHS-5 (2019–21) highlight a significant upward trajectory in the prevalence of overweight and obesity among children and adolescents in Bihar, reflecting broader national and global trends. The doubling of overweight prevalence among children aged 5–9 years (1.2% to 2.4%) and adolescents aged 10–19 years (3.2% to 4.5%) underscores the growing public health challenge posed by childhood overnutrition. Similarly, the doubling of obesity prevalence among adolescents from 1.1% to 2.3% during this period signals an urgent need for intervention.^{2,3}

Demographic disparities and underlying factors

Urban-rural divide

Urban areas report a higher prevalence of overweight (6.2%) and obesity (3.5%) compared to rural areas (2.8% and 1.5%, respectively). These disparities reflect the influence of urbanization on lifestyle transitions, including greater access to processed foods, reduced physical activity due to shrinking open spaces, and higher exposure to advertising for calorie-dense foods.^{4,5} Urban environments often promote sedentary behaviors such as increased screen time, further compounding the risk of obesity.^{6,7}

Gender differences

Boys exhibit slightly higher rates of overweight (2.6%) compared to girls (2.0%). This difference may be attributed to societal norms and behavioral patterns, where boys often have greater freedom to consume fast food and engage in sedentary activities such as playing video games. Girls, conversely, may face more restrictions on outdoor activities, impacting their physical activity levels differently.^{8,9}

Socioeconomic gradient

The pronounced prevalence of overweight and obesity among wealthier households and those with higher educational attainment highlights the role of socioeconomic factors in shaping dietary and lifestyle behaviors. Affluent families are more likely to have access to fast food, sugary beverages, and processed snacks while adopting sedentary lifestyles enabled by technological conveniences.^{10,11} On the other hand, lower-income groups, though historically less affected by overnutrition, are beginning to experience rising trends due to increased availability of inexpensive, calorie-dense foods.^{12,13} This trend underscores the dual burden of malnutrition, where undernutrition coexists with overnutrition within the same communities.¹⁴

Behavioral and environmental risk factors

Physical inactivity

The decline in physical activity is alarming, particularly among urban children. Reduced outdoor play and limited physical education in schools are significant contributors. Studies have shown a direct correlation between sedentary behavior and BMI increases in children.^{15,16} Moreover, urbanization in Bihar has led to shrinking open spaces, restricting children's opportunities for active play.

Dietary transitions

The shift from traditional diets to ultra-processed, calorie-dense foods is evident in Bihar, mirroring national and global trends. Increased consumption of sugary beverages, fried snacks, and fast foods has been linked to rising obesity rates. Nutrient labeling remains poorly understood, with many households unable to interpret food labels.^{17,18}

Screen time and sedentary lifestyles

Excessive screen time is a significant predictor of childhood obesity. The findings indicate a marked increase in screen time since NFHS-4, with urban children exhibiting the highest rates. Excessive screen exposure reduces physical activity and disrupts sleep patterns, both risk factors for obesity.^{19,20}

Socioeconomic disparities

Children from affluent households face greater risks due to higher consumption of energy-dense foods and sedentary lifestyles. However, obesity is also emerging among poorer groups as access to cheap, processed foods increases.⁸

UNICEF recommends integrating social and behavioral change strategies to modify dietary and physical activity behaviors. In Bihar, initiatives such as healthier school meal programs, active youth campaigns, and caregiver education can provide scalable solutions aligned with evidence-based practices.²⁵

Pathways forward

The findings from this study underscore the need for a multisectoral approach to addressing childhood obesity in Bihar.

Recommendations include fiscal policies like subsidies for fruits and vegetables and taxes on sugary drinks, enforcing restrictions on unhealthy food marketing in schools, and promoting physical activity through community and school initiatives.^{21,22} Strengthening monitoring systems to track trends and program outcomes will also be critical.^{23,24}

Implications for public health policy

The findings highlight the urgent need for targeted interventions to address obesity in Bihar. Key areas for action include:

Physical activity

The findings highlight the urgent need for targeted interventions to address obesity in Bihar. Encouraging physical activity through school programs, community initiatives, and infrastructure development for safe play spaces is essential. Community-based programs, such as the Fit India Movement, should be scaled to rural areas.¹ Schools and community centers can provide opportunities for structured physical activity, reducing the prevalence of sedentary lifestyles among children and adolescents.^{3,4}

Lifestyle behaviors

Promoting awareness about the risks of sedentary lifestyles and excessive screen time through public health campaigns is critical. Behavioral change communication programs tailored for caregivers and children can help reduce screen time and encourage active lifestyles. These campaigns should emphasize the importance of balance between recreational screen use and physical activity.^{5,6}

Nutrient labeling

Implementing clear, standardized food labeling can empower families to make healthier dietary choices. Nutrient labeling education campaigns, in collaboration with organizations like FSSAI, can improve consumer awareness of the caloric and nutritional content of foods. Policies promoting front-of-pack labeling for processed foods are vital to combat the growing availability of high-calorie, nutrient-poor food options.^{7,8}

Food environment

Regulating the availability and marketing of unhealthy food options in schools and communities, particularly those targeting children, is imperative. Policies restricting the sale of sugary beverages and ultra-processed snacks within school premises can significantly curb calorie-dense food consumption.^{9,10} Taxation of sugary drinks and subsidies for fruits and vegetables can help create a healthier food environment.^{11,12}

Home environment

Empowering parents to model healthy behaviors is equally important. Interventions to educate caregivers on balanced diets, meal planning, and reducing screen time for children can foster a supportive home environment. Family-based health interventions have been proven effective in creating sustained dietary and physical activity changes.^{13,14}

School-based strategies

Schools are uniquely positioned to address childhood obesity through interventions like developing nutritious meal standards, embedding physical activity into curricula, and creating choice architectures that promote healthier eating. For example, restructuring school meal programs to include nutrient-dense options and banning sugar-sweetened beverages can make a significant difference. In Bihar, pilot programs implementing these strategies could provide scalable models for state-wide application.^{15,16}

Use of large, representative datasets, such as NFHS-4 and NFHS-5, provides robust insights into the trends and determinants of overweight and obesity in Bihar. These nationally representative surveys ensure high-quality, comparable data across time periods, offering valuable information for evidence-based policymaking.² Incorporation of complementary evidence from organizations such as WHO and ICMR further enriches the analysis by providing broader global and national contexts to understand the dual burden of malnutrition.^{3,4}

Despite its strengths, the study has certain limitations. First, the lack of granular data on dietary intake and physical activity metrics limits the ability to precisely quantify the contributions of these factors to obesity trends.^{5,6} Second, the reliance on self-reported data for variables like screen time may introduce biases, potentially underestimating or overestimating the influence of these behaviors on obesity prevalence.^{7,8} Addressing these gaps in future studies could provide deeper insights into the behavioral determinants of childhood obesity.

Longitudinal studies are essential to understand the long-term impacts of interventions.^{9,10} Future research should also explore the interplay of genetic and environmental factors influencing childhood obesity in Bihar.^{11,12} Moreover, integrating targeted interventions into existing government programs, such as the National Nutrition Mission, will be vital for addressing the dual burden of malnutrition.^{13,14}

CONCLUSION

The findings highlight a significant rise in childhood overweight and obesity in Bihar, driven by urbanization, dietary transitions, and sedentary lifestyles. The study contributes to the understanding of the dual burden of malnutrition by emphasizing the coexistence of undernutrition and overnutrition. These insights inform targeted interventions, including promoting physical activity, improving nutrition literacy, and regulating the food environment. By addressing these drivers, policymakers can adopt evidence-based strategies to combat malnutrition in all its forms.

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