

Understanding Obesity through a Public Health Lens

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ABSTRACT

Obesity is a complex and chronic public health challenge that reflects deep-rooted social, economic, and environmental determinants rather than solely individual choices. Its global prevalence has risen sharply over recent decades, affecting more than one in eight people worldwide, with a growing burden in low- and middle-income countries. This paper explores obesity as a complex and growing public health challenge that extends beyond individual behavior. It highlights the social, economic, and environmental factors driving the epidemic, with a focus on the Indian context where undernutrition and overnutrition coexist. Recent research, population data, and policy reports were reviewed to analyze current trends, determinants, and the limitations of traditional measures such as the body mass index (BMI). Particular attention was given to South Asian populations, who are prone to obesity-related diseases at lower BMI thresholds. Global obesity rates have risen sharply, now affecting more than one in eight people, with a marked increase in low- and middle-income countries. In India, urbanization, sedentary lifestyles, and the easy availability of ultraprocessed foods have accelerated the problem across all age groups. The COVID-19 pandemic worsened the situation through reduced physical activity, stress, and food-system disruptions. Conventional BMI measures underestimate true metabolic risk in South Asians, underscoring the need for more nuanced diagnostic approaches. Obesity adds significantly to the burden of noncommunicable diseases and demands multisectoral action through healthier food policies, physical activity promotion, and early prevention. Integrating these strategies into health systems is vital to reduce its long-term impact.

Keywords: Body mass index, Noncommunicable diseases, Nutrition transition, Obesity, Public health.

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INTRODUCTION

The escalating prevalence of obesity worldwide necessitates a fundamental reevaluation of its underlying causes and appropriate public health responses. For too long, the discourse surrounding obesity has narrowly focused on individual dietary choices and physical activity levels, implicitly assigning blame to those affected. However, a critical public health perspective reveals that obesity is far more complex than a simple matter of personal willpower. The World Health Organization (WHO) defines obesity as “abnormal or excessive fat accumulation that may impair health.”¹ This definition, while foundational, must be understood within a broader context that recognizes obesity as a “complex, heterogeneous, chronic, and progressive disease.” However, obesity is a complex, chronic disease driven by systemic issues economic, social, and political rather than merely a consequence of individual choices.²

The global burden of obesity presents an alarming trajectory. In 2016, over 1.9 billion adults were classified as overweight, with 650 million of these categorized as obese. Projections indicate that by 2030, more than 1 billion people worldwide will be obese.³ More recent data suggest that obesity

now affects more than one in eight people globally.^{1,4} A particularly concerning aspect of this epidemiological shift is the rapid increase in low- and middle-income countries (LMICs). This trend is accompanied by significant disparities in prevalence across different socioeconomic strata, notably affecting women more profoundly.⁵ The prevalence of childhood obesity has also surged, with an estimated 39 million children under five being overweight or obese in 2022. Alarming, obesity rates among adolescents have quadrupled since 1980.^{6,7} According to the National Family Health Survey (NFHS-5, 2019–21), 24% of women and 22.9% of men aged 15–49 years were overweight or obese, a notable increase from previous surveys in India.⁸ The Comprehensive National Nutrition Survey (CNNS) of children and adolescents further revealed that approximately 5% of children aged 5–19 years were obese.⁹

This nutritional duality, where undernutrition and overnutrition coexist within the same communities and even households, creates a highly intricate policy environment. Interventions designed to address one form of malnutrition could inadvertently worsen the other if not meticulously planned and implemented. For instance, strategies focused on increasing

calorie availability to combat undernutrition might inadvertently exacerbate obesity if they promote access to cheap, unhealthy, calorie-dense but nutrient-poor foods. This situation demands highly nuanced, integrated nutrition policies that address both ends of the malnutrition spectrum simultaneously. The focus must shift toward ensuring access to nutrient-dense, healthy food for all, rather than merely focusing on calorie sufficiency. Such integrated strategies are crucial for developing effective and sustainable responses to India's unique public health landscape.

MATERIALS AND METHODS

A systematic and comprehensive search of the literature was conducted across major electronic databases, including PubMed and Google Scholar, to capture gray literature and policy documents. The search covered studies published between 2010 and 2025, ensuring inclusion of contemporary perspectives shaped by recent developments such as urbanization, lifestyle changes, and the COVID-19 pandemic. Keywords and combinations such as “obesity,” “public health,” “determinants,” “India,” “policy response,” and “epidemiology” were used. Reference lists of key papers were also screened to identify additional relevant sources.

Studies were included if they addressed obesity from a population or policy perspective, examined determinants such as diet, physical activity, environment, or socioeconomic context, or discussed frameworks for prevention and management. Articles focusing solely on pharmacological or surgical interventions, or those unrelated to human populations, were excluded.

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RESULTS

Critical Examination of Obesity Definition and Diagnosis

Body mass index (BMI), calculated as weight in kilograms divided by the square of height in meters (kg/m^2), remains the most commonly used indicator for classifying overweight and obesity, with a BMI of $\geq 30 \text{ kg}/\text{m}^2$ generally considered obese.¹⁰ For South Asians, the cut-off values for central obesity and related anthropometric indicators are generally lower due to their higher risk of cardiometabolic diseases at lower body fat levels. The recommended values are as follows:¹¹

- Stage 1 obesity is characterized by increased adiposity ($\text{BMI} \geq 23 \text{ kg}/\text{m}^2$) without noticeable impairment of organ function or limitations in daily activities. Stage 2 obesity represents a more advanced state with generalized and abdominal fat accumulation, adversely affecting physical and organ functions, leading to restrictions in day-to-day activities and the development of comorbid conditions.¹²
- The classification of stage 2 obesity requires a $\text{BMI} \geq 23 \text{ kg}/\text{m}^2$ (as per South Asian cut-offs, where $\geq 23 \text{ kg}/\text{m}^2$ indicates overweight and $\geq 25 \text{ kg}/\text{m}^2$ indicates obesity), along with at least one of the following indicators of excess adiposity:
 - Waist circumference (WC): $\geq 90 \text{ cm}$ for men, $\geq 80 \text{ cm}$ for women.
 - Waist-to-hip ratio (WHR): >0.90 for men, >0.80 for women.
 - Body fat percentage: $>25\%$ in men, $>32\%$ in women.

Additionally, the presence of one or more symptoms reflecting functional limitations in daily activities or one or more obesity-related comorbidities is required to support the diagnosis of stage 2 obesity.

Body mass index is a simple and widely used tool to classify individuals based on weight relative to height, but it has several limitations. BMI cut-offs were originally developed based on European populations and may not accurately capture obesity-related risks in other ethnic groups, such as South Asians, who face higher health risks at lower BMI levels. It also overlooks factors like age, sex, body composition, and fitness level, limiting its effectiveness as a standalone tool for assessing individual health risk. The primary weakness in BMI measurement is that it does not differentiate between fat mass and muscle mass, which can lead to misclassification—muscular individuals may be labeled as overweight or obese, while people with high body fat but low muscle mass (e.g., in sarcopenic obesity) may fall within a “normal” BMI range. BMI also does not reflect

fat distribution, particularly harmful visceral fat around internal organs, which is more strongly associated with metabolic risks. This is particularly relevant for non-White populations, such as Asians, who may experience obesity-related health consequences at lower BMI ranges due to higher visceral fat accumulation, a phenomenon known as the Yajnik-Yudkin (Y-Y) paradox.¹³

To overcome the primary weakness of BMI as an assessment tool for obesity, assessing body compartments through multi- or compartmental models is essential for accurately understanding and managing obesity, far beyond what simple metrics such as BMI can reveal. Classic two-compartment models distinguish between fat mass and fat-free mass, but they often mask key differences in the distribution of water, bone, and protein. More advanced models such as the six-compartment model using *in vivo* neutron activation analysis offer the precision necessary to evaluate total body fat more reliably, serving as a gold standard for comparing other methods (Fig. 1).¹⁴

The redefinition of treatment success is a profound implication of this new diagnostic paradigm. The primary goal of care when treating obesity is health gain, with weight loss serving as a surrogate marker of treatment effectiveness. This means that success in management should be assessed by the improvement or reversal of signs and symptoms, and the regaining or improvement of functions, rather than solely by measures of weight loss.¹⁵ If health systems continue to prioritize BMI reduction as the sole measure of success, they risk overlooking meaningful health improvements in patients who do not achieve large weight losses, or conversely, failing to address underlying health issues in those who lose weight but still experience organ dysfunction.

Evolving Diagnostic Paradigms: Toward Clinical and Preclinical Obesity

Recognizing the limitations of BMI, a more accurate and clinically relevant approach to diagnosing obesity is emerging.¹⁶ A new diagnostic paradigm proposed by the Lancet Diabetes and Endocrinology Commission moves beyond BMI to focus on other measures of body fat and objective signs and symptoms of ill health. This new approach introduces two distinct categories: preclinical and clinical obesity. Preclinical obesity is a condition where an individual has excess body fat but does not yet show signs of illness or organ dysfunction. These individuals can carry out daily activities normally, but they are at a higher risk of progressing to clinical obesity and developing conditions such as cardiovascular disease, type 2 diabetes, and certain cancers. In contrast, clinical obesity is recognized as a chronic disease in which obesity itself causes noticeable symptoms and reduced organ or tissue function. People with clinical obesity may experience breathlessness, joint pain, or metabolic abnormalities, and may have dysfunctions in systems such as the heart, lungs, kidneys, or reproductive organs, impacting their quality of life and daily functioning. This distinction is vital for tailoring interventions and resource allocation more effectively.

Table 1 visually demonstrates how relying on BMI alone can lead to misclassification, either overdiagnosing individuals with high muscle mass or underdiagnosing those with excess fat but a lower BMI. It clearly illustrates the two new categories - preclinical and clinical obesity and how they are determined by both body fat and health status. However, there is another paradigm is metabolically healthy obesity (MHO). It refers to a condition in which individuals classified as obese

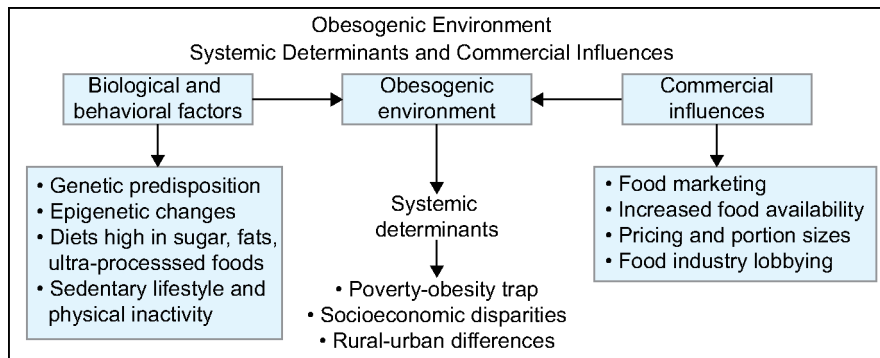
One compartment model	Body weight					
Two compartment model	Fat mass (FM)		Fat free mass (FFM)			
Three compartment model*	Fat mass (FM)		Total body water (TBW)	Fat free dry mass (FFDM) (BMC + metabolic tissue)		
Three compartment model**	Fat mass (FM)		Bone mineral content (BMC)	Lean tissue mass (LTM) (TBW + metabolic tissue)		
Four compartment model	Fat mass (FM)	Total body water (TBW)	Bone mineral content (BMC)	Metabolic tissue		
Five compartment model	Fat mass (FM)	Total body water (TBW)	Bone mineral content (BMC)	Soft tissue mineral	Residual tissue	
Six compartment model	Fat mass (FM)	Total body water (TBW)	Bone mineral content (BMC)	Soft tissue mineral	Glycogen	Protein

Fig. 1: Body compartment model for obesity assessment¹⁴. *Siri model; **DXA model

Table 1: Traditional vs new clinical obesity diagnosis¹⁶

	BMI (kg/m ²)	Excess body fat	Muscle mass	Signs/symptoms?*	Old diagnosis	New diagnosis
1	28.2	Yes	Normal/Low	No	Overweight	Underdiagnosis of obesity (Preclinical obesity)
2	30.1	No	High	No	Obesity	Overdiagnosis of obesity (No obesity)
3	36.2	Yes	Normal/Low	No	Obesity	Preclinical obesity
4	36.2	Yes	Normal/Low	Yes	Obesity	Clinical obesity
5	23.7	No	Normal/High	No	No obesity	No obesity
6	28.8	No	Normal	No	Overweight	No obesity
7	28.8	Yes	Normal/Low	No	Overweight	Preclinical obesity
8	32.4	No	High	No	Obesity	No obesity
9	39.2	Yes	Normal/Low	No	Obesity	Preclinical obesity
10	39.2	Yes	Normal/Low	Yes	Obesity	Clinical obesity

*Signs and symptoms of organ dysfunction due to excess body fat

**Fig. 2:** Obesogenic environment (Illustrated based on the text)

based on body mass index (BMI) or body fat percentage do not exhibit the typical metabolic abnormalities associated with obesity, such as insulin resistance, high blood pressure, dyslipidemia, or elevated blood glucose levels. These individuals generally have a favorable metabolic profile, including normal insulin sensitivity, healthy lipid levels, and absence of metabolic syndrome, and may possess less visceral fat despite having overall high adiposity. However, MHO is considered a transient and potentially unstable state, as many individuals may transition to a metabolically unhealthy status over time. It signals a necessary shift in how obesity is identified and managed at a population level, moving toward a more precise and health-outcome-oriented approach.

Obesogenic Environment: Systemic Determinants and Commercial Influences

While environmental and systemic factors play a dominant role in the obesity epidemic, biological and behavioral elements provide a foundational context. Obesity has a strong genetic component, with twin, family, and adoption studies estimating that 40–70% of variation in BMI is heritable.^{17–19} Furthermore, epigenetic changes, particularly those occurring *in utero* due to maternal obesity

or malnutrition (as posited by the Barker hypothesis), can predispose individuals to obesity and related metabolic diseases later in life. Sedentary behavior, excessive screen time, irregular sleep patterns, and stress-related eating are significant contributors. Diets rich in sugar, saturated fats, and ultraprocessed foods are prevalent in both urban and rural settings.^{20,21}

Socioeconomic status (SES) profoundly influences the prevalence and trajectory of obesity. While historically associated with affluence, obesity rates are now increasingly observed in lower-income and rural populations, often due to the greater availability and affordability of cheap, unhealthy foods. This creates a paradox where poverty, traditionally linked to undernutrition, now also drives obesity, forming a “poverty-obesity trap.”²² This is particularly evident in LMICs, where more than half of the global rise in mean BMI between 1985 and 2017 was attributed to increases in rural areas, with BMI rising faster in rural than urban settings (Fig. 2).²³

The food industry’s aggressive marketing of calorie-dense, nutrient-poor products, particularly targeting children through digital media, is a major concern. These commercial determinants include increased food availability, strategic food marketing, pricing

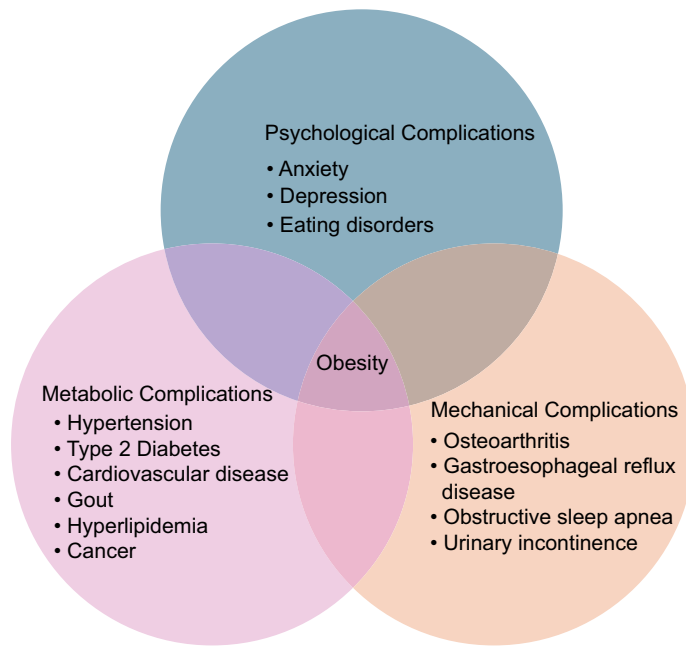
strategies that favor unhealthy options, ever-expanding portion sizes, high energy density, and the widespread ultraprocessing of foods and artificial sweeteners.^{24–26} The influence of large commercial interests extends beyond marketing to actively shape the policy environment. “Food industry lobbying against regulations” is identified as a significant challenge.²⁷ This consistent emphasis across multiple authoritative sources indicates that commercial entities are not just influencing individual choices but are actively shaping the obesogenic environment and hindering effective public health policy.

Childhood and Adolescent Obesity: A Public Health Catastrophe

Childhood and adolescent obesity represent an urgent public health concern due to its rapid escalation and profound long-term implications for future generations. The rates of obesity among adolescents have quadrupled since 1980.²⁸ This trend is particularly alarming because overweight children are highly likely to remain obese into adulthood, leading to the earlier onset of chronic diseases typically associated with adult obesity. The factors contributing to childhood obesity are complex, involving a mix of genetic susceptibility, poor dietary habits, insufficient physical activity, and adverse socio-environmental influences. Early-life exposures play a critical role; for instance, epigenetic changes occurring *in utero* due to maternal obesity or malnutrition (as posited by the Barker hypothesis) can predispose individuals to obesity later in life. Maternal health, including prepregnancy weight, gestational diabetes, and nutritional status, plays a crucial role in shaping fetal metabolism and future obesity risk. In infancy, breastfeeding, timely and appropriate complementary feeding, and avoiding rapid weight gain are protective. As children grow, dietary habits, physical activity levels, screen

Table 2: Levels of prevention in obesity as per Leavell and Clark model

Level of prevention	Goal	Key strategies
Primordial prevention	Prevent the development of obesity risk factors	Urban planning for walkability and cycling, exclusive breastfeeding, food policy reforms (e.g., sugar tax, trans-fat ban, front-of-pack labeling), strict regulation of food advertising (especially to children)
Primary prevention	Prevent the onset of obesity in healthy individuals	Community awareness campaigns, school-based physical activity and nutrition programs
Secondary prevention	Detect early risk and prevent progression to clinical obesity	Routine/opportunistic screening for high BMI, waist circumference, and early signs of metabolic disorders
Tertiary prevention	Manage established obesity and prevent complications	Pharmacotherapy, bariatric surgery, clinical management to improve quality of life

**Fig. 3:** Complications of obesity

time, and family and school environments significantly influence their weight trajectory. During adolescence, hormonal changes, increased autonomy, peer influence, mental health issues, and body image concerns further impact behaviors related to food and physical activity.^{29–31} Since obesity during childhood and adolescence often tracks into adulthood, leading to chronic diseases such as diabetes and cardiovascular conditions, early and sustained interventions are vital.

Impact of COVID-19 on Obesity

The COVID-19 pandemic significantly worsened the global obesity crisis. Lockdowns, school closures, and restrictions on movement led to reduced physical activity and increased sedentary behavior, especially among children and adolescents. Simultaneously, increased stress, anxiety, and disrupted routines contributed to emotional eating and greater consumption of unhealthy, processed foods. Limited access to fresh produce, irregular meal patterns, and screen-time overload further fueled

weight gain.³² Health services were diverted toward pandemic response, disrupting routine obesity prevention, screening, and management efforts. Moreover, people with obesity faced higher risks of severe COVID-19 outcomes, including hospitalization, ICU admission, and mortality, highlighting the need for integrated obesity care in future health preparedness strategies.

Consequences of Obesity

Obesity significantly contributes to the global burden of noncommunicable diseases, increasing the risk of type 2 diabetes, hypertension, heart disease, stroke, MASLD, and chronic kidney disease. Visceral fat promotes insulin resistance and inflammation, while excess weight stresses joints, leading to osteoarthritis. Obesity also impacts reproductive health, causing PCOS, infertility, and pregnancy complications. Beyond physical health, obesity affects mental well-being, with stigma and discrimination contributing to depression, anxiety, and low self-esteem. This bidirectional relationship

between obesity and depression highlights its profound impact on both physical and psychological health, ultimately reducing overall quality of life (Fig. 3).^{33–37}

The economic burden of obesity is substantial, imposing significant strain on healthcare systems and national economies worldwide. Beyond direct medical expenditures, there are considerable indirect costs, including loss of productivity due to illness, disability, and premature mortality. Globally, the current estimated economic costs of obesity are approximately 2.8% of the world's gross domestic product (GDP). In low-resource settings, such as India, the financial impact is particularly severe, as out-of-pocket expenditure for healthcare services further exacerbates financial stress on individuals and families.³⁸

Prevention of Obesity

Obesity prevention requires early and sustained efforts through healthy eating, regular physical activity, behavior change, and supportive environments. In children, family-based dietary changes, reduced screen time, and daily exercise are essential, while adults benefit from portion control, whole foods, and consistent physical activity. Promoting lifelong healthy habits is key to reducing obesity risk.³⁹ Breastfeeding plays a critical role in preventing childhood obesity, offering both immediate and long-term protective effects.⁴⁰ Exclusive breastfeeding for the first six months, as recommended by the WHO and UNICEF, and continued breastfeeding along with appropriate complementary foods, has been shown to lower the risk of obesity and related metabolic disorders later in childhood and adolescence (Table 2).^{41,42}

Various national and global initiatives have been launched to combat obesity. In India, programs such as Poshan Abhiyaan (combating malnutrition through awareness), Eat Right India (promoting healthy eating and food safety), Fit India Movement (encouraging physical activity), and Khelo India (enhancing sports infrastructure) represent significant efforts. Globally, frameworks such as the WHO

Table 3: Government initiatives to combat obesity in India

Program/initiative	Ministry/agency	Focus area
NP-NCD (formerly NPCDCS)	Ministry of Health and Family Welfare	Prevention, early detection, and management of NCDs
Fit India Movement (2019)	Ministry of Youth Affairs and Sports	Promoting physical fitness and active lifestyle
Poshan Abhiyaan	Ministry of Women and Child Development	Improving nutritional outcomes among children and women
School Health Program	MoHFW and MoE (under Ayushman Bharat)	Health education, screening, and promotion in schools
Eat Right India Movement	FSSAI	Safe, healthy, and sustainable food choices
Khelo India Program	Ministry of Youth Affairs and Sports	Sports infrastructure and fitness programs for youth
Yoga and Wellness Initiatives	Ministry of AYUSH	Promotion of yoga and traditional wellness practices

“Best Buys,” Global Syndemic Commission recommendations, and the WHO Acceleration Plan to Stop Obesity provide evidence-based policy guidelines, emphasizing multisectoral and equity-centered approaches (Table 3).⁴³

Despite these initiatives and the existence of comprehensive prevention strategies, a critical assessment reveals a significant gap between policy recommendations and real-world impact. Low awareness about the health risks of obesity and resistance to behavior change are significant barriers, often compounded by cultural norms and family practices.⁴⁴ The pervasive influence of the food industry through lobbying and dissemination of misleading information complicates public understanding and policy enforcement. A unique challenge in countries like India is the coexistence of undernutrition and obesity, representing a double burden of malnutrition that requires nuanced, context-specific approaches.⁴² A comprehensive public health approach to obesity requires interventions across multiple levels of prevention.³⁹

CONCLUSION AND RECOMMENDATIONS

The global obesity epidemic is not merely a matter of individual responsibility or a cosmetic concern; it is a complex societal issue deeply rooted in globalization, systemic inequity, and profoundly unhealthy environments. This chronic disease drives a large proportion of the global noncommunicable disease burden, posing a significant threat to economic development, healthcare sustainability, and the overall quality of life worldwide. Healthcare systems must be strengthened to integrate obesity prevention and management within national NCD programs, especially at the primary care level through routine screening and counseling. Training frontline health workers and addressing weight bias in medical education are essential to ensure empathetic, evidence-based care for obesity as a chronic disease. Governments must implement strong food policy reforms such as sugar taxes, trans-fat bans, front-of-pack

labeling, and restrictions on digital marketing to children to reduce exposure to unhealthy products. Additionally, subsidies should shift from harmful commodities to nutritious foods and sustainable infrastructure to combat the Global Syndemic.

AUTHOR CONTRIBUTIONS

BKP conceptualized the review topic, provided overall supervision, and guided the intellectual framework of the manuscript. SR contributed to the study design, supervised the literature search and evidence synthesis, and critically reviewed the manuscript for important intellectual content. PR conducted the comprehensive literature search, screening, data extraction, and drafted the initial manuscript. All authors reviewed, edited, and approved the final version of the manuscript.

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REFERENCES

- World Health Organization. (2025) Obesity [online]. Available from: <https://www.who.int/news-room/facts-in-pictures/detail/6-facts-on-obesity> [Last accessed July, 2026].
- The Lancet. (2026). Obesity [online]. Available from: <https://www.thelancet.com/clinical/diseases/obesity> [Last accessed July, 2026].
- World Health Organization. (2025). Obesity and overweight [online]. Available from: <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight> [Last accessed July, 2026].
- World Obesity Federation. (2022). Prevalence of obesity [online]. Available from: <https://www.worldobesity.org/about/about-obesity/prevalence-of-obesity> [Last accessed July, 2026].
- Popkin BM, Slining MM. New dynamics in global obesity facing low- and middle-income countries. *Obes Rev* 2013;14(Suppl 2):11–20.
- Sanyaolu A, Okorie C, Qi X, et al. Childhood and adolescent obesity in the United States:

a public health concern. *Glob Pediatr Health* 2019;6:2333794X19891305.

- World Health Organization. (2025). Noncommunicable diseases: childhood overweight and obesity [online]. Available from: <https://www.who.int/news-room/questions-and-answers/item/noncommunicable-diseases-childhood-overweight-and-obesity> [Last accessed July, 2026].
- National Family Health Survey. (2017). NFHS [online]. Available from: <https://www.nfhsips.in/nfhsuser/nfhs5.php> [Last accessed July, 2026].
- Ministry of Health and Family Welfare, Government of India. (2026). Comprehensive National Nutrition Survey 2016–2018. [online]. Available from: <https://nhm.gov.in/WriteReadData/18925/1405796031571201348.pdf>
- Zierle-Ghosh A, Jan A. Physiology, body mass index. In: StatPearls [online]. StatPearls Publishing; 2025. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK535456/> [Last accessed July 20, 2025].
- Lopez-Jimenez F, Miranda WR. Diagnosing obesity: beyond BMI. *AMA J Ethics* 2010;12(4):292–298.
- Misra A, Vikram NK, Ghosh A, et al. Revised definition of obesity in Asian Indians living in India. *Diabetes Metab Syndr* 2025;19(1):102989.
- Yajnik CS, Yudkin JS. The Y-Y paradox. *Lancet* 2004;363(9403):163.
- Müller MJ, Braun W, Pourhassan M, et al. Application of standards and models in body composition analysis. *Proc Nutr Soc* 2016;75(2):181–187.
- Rodrigues Silva Sombra L, Anastasopoulou C. Pharmacologic therapy for obesity. In: StatPearls [online]. StatPearls Publishing; 2025. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK562269/> [Last accessed July, 2026].
- Rubino F, Cummings DE, Eckel RH, et al. Definition and diagnostic criteria of clinical obesity. *Lancet Diabetes Endocrinol* 2025;13(3):221–262.
- Lee A, Carde M, Donahoe WT. Social and environmental factors influencing obesity. In: Feingold KR, Ahmed SF, Anawalt B, et al. (Eds). *Endotext*. MDText.com, Inc 2000.
- Yadav HM, Jawahar A. Environmental factors and obesity. In: StatPearls [online]. StatPearls Publishing; 2025. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK580543/> [Last accessed July, 2026].
- Kahan LG, Mehrzad R. Environmental factors related to the obesity epidemic. In: Mehrzad R (Ed). *Obesity*. Elsevier; 2020. pp. 117–139.
- Affenito SG, Franko DL, Striegel-Moore RH, et al. Behavioral determinants of obesity: research findings and policy implications. *J Obes* 2012;2012:150732.
- Rennie KL, Johnson L, Jebb SA. Behavioural determinants of obesity. *Best Pract Res Clin Endocrinol Metab* 2005;19(3):343–358.
- Capoccia D, Milani I, Colangeli L, et al. Social, cultural and ethnic determinants of obesity: from pathogenesis to treatment. *Nutr Metab Cardiovasc Dis* 2025;35(6):103901.
- NCD Risk Factor Collaboration. Rising rural body-mass index is the main driver of the global obesity epidemic in adults. *Nature* 2019;569(7755):260–264.
- Story M, French S. Food advertising and marketing directed at children and adolescents in the US. *Int J Behav Nutr Phys Act* 2004;1:3.

25. Omoruyi AJ, Durojaye E. Misleading marketing of unhealthy foods and beverages to children in South Africa as a consumer protection issue. *J Consum Policy* 2025;48:105–131.
26. Edwards M. The Barker hypothesis. In: *Handbook of Famine, Starvation, and Nutrient Deprivation*. Cham: Springer; 2017. pp. 1–21.
27. The Sumner M Redstone Global Center for Prevention and Wellness. (2026). Report. Lancet Commission examines the “global syndemic”: the interplay of obesity, undernutrition and climate change, co-chaired by Bill Dietz [online]. Available from: <https://redstone.publichealth.gwu.edu/report-lancet-commission-examines-global-syndemic-interplay-obesity-undernutrition-climate-change> [Last accessed July, 2026].
28. Centers for Disease Control and Prevention. (2024). Childhood obesity facts [online]. Available from: <https://www.cdc.gov/obesity/childhood-obesity-facts/childhood-obesity-facts.html> [Last accessed July, 2026].
29. Pérez-Escamilla R, Kac G. Childhood obesity prevention: a life-course framework. *Int J Obes Suppl* 2013;3(Suppl 1):S3–S5.
30. Sahoo K, Sahoo B, Choudhury AK, et al. Childhood obesity: causes and consequences. *J Family Med Prim Care* 2015;4(2):187–192.
31. Xu S, Xue Y. Pediatric obesity: causes, symptoms, prevention and treatment. *Exp Ther Med* 2016;11(1):15–20.
32. Nour TY, Altıntaş KH. Effect of the COVID-19 pandemic on obesity and its risk factors: a systematic review. *BMC Public Health* 2023;23:1018.
33. Safaei M, Sundararajan EA, Driss M, et al. A systematic literature review on obesity: understanding the causes and consequences of obesity and reviewing various machine learning approaches used to predict obesity. *Comput Biol Med* 2021;136:104754.
34. World Health Organization. (2024). Obesity: health consequences of being overweight [online]. Available from: <https://www.who.int/news-room/questions-and-answers/item/obesity-health-consequences-of-being-overweight> [Last accessed July, 2026].
35. Djalalinia S, Qorbani M, Peykari N, et al. Health impacts of obesity. *Pak J Med Sci* 2015;31(1):239–242.
36. Centers for Disease Control and Prevention. (2022). Causes and consequences of childhood obesity [online]. Available from: <https://www.cdc.gov/obesity/basics/consequences.html> [Last accessed July, 2026].
37. Sarwer DB, Polonsky HM. The psychosocial burden of obesity. *Endocrinol Metab Clin North Am* 2016;45(3):677–688.
38. Okunogbe A, Nugent R, Spencer G, et al. Economic impacts of overweight and obesity: current and future estimates for eight countries. *BMJ Glob Health* 2021;6(10):e006351.
39. Johns Hopkins Medicine. (2024) Obesity prevention [online]. Available from: <https://www.hopkinsmedicine.org/health/conditions-and-diseases/obesity/preventing-obesity> [Last accessed July, 2026].
40. Harvard Health Publishing. (2018). The real link between breastfeeding and preventing obesity [online]. Available from: <https://www.health.harvard.edu/blog/the-real-link-between-breastfeeding-and-preventing-obesity-2018101614998> [Last accessed July, 2026].
41. World Health Organization. (2023). Exclusive breastfeeding to reduce the risk of childhood overweight and obesity [online]. Available from: <https://www.who.int/tools/elena/interventions/breastfeeding-childhood-obesity> [Last accessed July, 2026].
42. Harvard TH Chan School of Public Health. (2017). Obesity [online]. Available from: <https://hsph.harvard.edu/news/obesity/> [Last accessed July, 2026].
43. Press Information Bureau, Government of India. (2025). Toward a fit and healthy India: combating obesity through collective action [online]. Available from: <https://www.pib.gov.in/www.pib.gov.in/Pressreleaseshare.aspx?PRID=2107179> [Last accessed July, 2026].
44. Unnikrishnan AG, Chowdhury S, Pedersen SD, et al. Perceptions, attitudes and barriers to effective obesity care among people with obesity and health care professionals in India. *Diabetes Obes Metab* 2024;26(10):4791–4794.