

ORIGINAL RESEARCH ARTICLE

Food security, malnutrition, and obesity in India: A correlational study

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Abstract

The study examined the relationship between food availability, access, utilization, malnutrition, and obesity in India during 1995-2020, as per the data available at five-year time gaps. Taking a graphical analysis approach, the study explored the interlinkage among food security, malnutrition, and obesity. The results showed a steady rise in both food availability and obesity over the years. The study also noted the rising food accessibility and utility, and its concurrence with obesity trends. Despite the improvement in food security, the trend in the prevalence of malnutrition was paradoxical, declining at first but bouncing back by 2020. The study concluded that while food security in terms of availability had increased, it had led to more consumption of calorie-dense processed food, which had led to more obesity. It suggested ways to raise awareness of the risks of poor diet, regulate junk food marketing, promote physical activity, improve access to nutritious food, and make food distribution systems more resilient to fight India's double burden of obesity and malnutrition. (*Afr J Reprod Health* 2025; 29 [11]: 223-232).

Keywords: Food availability, food accessibility, food utility, obesity, malnutrition

Résumé

L'étude a examiné la relation entre la disponibilité, l'accès et l'utilisation des aliments, la malnutrition et l'obésité en Inde entre 1995 et 2020, d'après les données disponibles avec un intervalle de cinq ans. À l'aide d'une analyse graphique, l'étude a exploré les liens entre sécurité alimentaire, malnutrition et obésité. Les résultats ont montré une augmentation constante de la disponibilité et de l'obésité au fil des ans. L'étude a également noté une accessibilité et une utilité croissantes des aliments, ainsi que leur concordance avec les tendances à l'obésité. Malgré l'amélioration de la sécurité alimentaire, la prévalence de la malnutrition a connu une tendance paradoxale : une baisse initiale, suivie d'un rebond en 2020. L'étude a conclu que si la sécurité alimentaire s'était améliorée, elle avait entraîné une consommation accrue d'aliments transformés riches en calories, ce qui avait aggravé l'obésité. Elle a suggéré des pistes pour sensibiliser aux risques d'une mauvaise alimentation, réglementer le marketing de la malbouffe, promouvoir l'activité physique, améliorer l'accès à une alimentation nutritive et renforcer la résilience des systèmes de distribution alimentaire afin de lutter contre le double fardeau de l'obésité et de la malnutrition en Inde. (*Afr J Reprod Health* 2025; 29 [11]: 223-232).

Mots-clés: Disponibilité alimentaire, accessibilité alimentaire, utilité alimentaire, obésité, malnutrition.

Introduction

Obesity is a chronic and multifaceted disease with an increased deposition of body fat, which has adverse effects on health, increases the risk of chronic medical conditions, and reduces lifespan¹. Obesity is known globally as a condition that progresses in its course, and it has significant psychosocial effects as well as being a high-risk factor for type 2 diabetes². Initially considered a

problem of high-income countries, obesity has spread rapidly to middle- and low-income nations and is currently a global public health priority. Between 1975 and 2016, the prevalence of obesity nearly tripled worldwide. If current trends are kept up, projections suggest that by the year 2025, close to 2.7 billion adults will be overweight, over 1 billion will be obese, and close to 177 million will be severely affected by obesity³⁻⁵. India hasn't been left behind by the trend.

Obesity has hitherto been a largely urban concern but now extends to suburban and rural regions as well⁶⁻⁸. India was the sixth country in the world with the highest ratio of obese adults in the year 2022, with 4% of India's adult population being obese⁹. The latest findings of the National Family Health Survey-5 (NFHS-5) indicate a rise in the rates of overweight and obesity, where 24% of Indian women and 23% of men are overweight or obese, against 20.5% and 18.9%, respectively, in NFHS-4⁴. This increasing trend has been attributed to several factors, including changing dietary patterns, increased consumption of ultra-processed foods (UPFs), the COVID-19 pandemic, food supply, and lifestyle^{7,8,10,11}.

Food security is a critical aspect in obesity and malnutrition discourse. The Food and Agriculture Organization (FAO) defines food security as a situation in which all people at all times have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs for an active and healthy life¹². Food security has four principal components: availability, accessibility, stability, and utilization¹⁰. Although India has enhanced agricultural production and food availability, food insecurity continues to be a concern and is a cause of a double burden of malnutrition- undernutrition and obesity occurring in the same population. The government of India has placed a number of measures to enhance food security, ranging from raising food grain production to controlling grain markets, maintaining reserves of food grains, and operating a public distribution system. The National Food Security Act (NFSA) was enacted in order to grant all citizens access to sufficient and healthy food, thus ensuring social and economic stability^{12,13}. Nevertheless, despite all these efforts, the link between food security, malnutrition, and obesity is not well studied yet.

While obesity has long been attributed to excessive calorie intake, evidence suggests that

food insecurity may also cause obesity due to inadequate diet quality, reliance on energy-dense, nutrient-poor foods, and limited access to healthier options¹⁰. Despite the significance of food security and malnutrition in India, few studies have been conducted to comprehensively examine their relationship with obesity. Most of the literature addresses undernutrition, while the interaction between food insecurity and obesity has been less explored, particularly in the context of India's diverse socioeconomic and geographical setting. In addition, few studies investigate how dietary diversity and food security have influenced obesity trends over time, particularly among rural and marginalized groups. While there exist helpful national surveys such as NFHS, there is a scarcity of long-term trend analysis in India on food security relative to obesity.

This research aims at filling the gap in research by examining the link between food security, malnutrition, and obesity in India. The study is specifically concerned with examining trends in food availability, food accessibility, malnutrition, and obesity in India between the periods 1995-2020 with surveys conducted every five years. Through these objectives, this study will have a detailed understanding of the interrelationship between food security, malnutrition, and obesity in India. The findings will benefit policymakers, public health professionals, and researchers keen on developing targeted interventions to combat obesity without jeopardizing food security and improving nutritional status.

Literature review

Luhar *et al.*¹⁴ extrapolated overweight and obesity prevalence in India from 2010 to 2040 using multi-state life tables. They estimated incidence of overweight and baseline prevalence from national surveys and extrapolated mortality using the Lee-Carter model, with BMI-related hazards. The study

approximated that by the year 2040, overweight among men and women of age 20–69 years would be 30.5% and 27.4%, respectively, and obesity levels would increase to 9.5% and 13.9%, respectively. The largest projected increases occurred among older individuals and rural dwellers, meaning a shift of excess weight patterns and highlighting the need for differential health policies.

Jaacks *et al.*¹⁵ studied the impact of COVID-19 on Indian agriculture using phone interviews with 1,437 farmers across 12 states. The study revealed that 11% of farmers could not harvest (37% due to weather, 24% due to lockdown). Among those who harvested, only 44% sold their produce, and 39% kept them, mainly due to lockdown disruptions. Income declines hit 79% of wage-worker households, and food insecurity disproportionately affected landless farmers (18% went without meals versus 2% of large farmers). Dietary diversity declined dramatically—daily dairy consumption decreased from 94–95% to 63%, vegetable intake from 64–65% to 40%, and fruit intake from 42–43% to 7%. The study showed how lockdowns upset crop sales, reduced wages, and compromised nutrition.

Prasad *et al.*¹⁶ examined the influence of household economic status, social inequality, mother's BMI education, and education on malnutrition among children in India based on NFHS-4 data of 259,627 under-five children. Child stunting and underweight were higher among children of underweight mothers, poor families, working mothers, and home births. Malnutrition was also higher among children of scheduled tribes and castes, illiterate mothers, and rural villages. The risk of underweight and stunting was over twice as great among children in poor families, and 40% of the children involved were from poor families. Special interventions to ensure nutrition among children were deemed critical, as the research brought out. Fathelrahman *et al.*⁷ examined high-

income country agricultural and food system determinants of undernourishment and obesity using panel data from the years 2000–2020. Econometric estimates showed that per capita GDP, urbanization, and food retailing losses significantly influenced the prevalence of undernourishment, while supply of fatty foods was the most significant nutritional determinant. The determinants of obesity were found to be cereal import dependence, per capita GDP, food import-export balance, and domestic food production. The study recommended transforming food systems for sustainability and mitigating urbanization's negative effects.

Ulahannan *et al.*¹⁷ compared NFHS-5 data to assess severe acute malnutrition (SAM) trends in India and noted a dramatic rise in the background of economic growth. SAM was increasingly prevalent in identified malnutrition pockets but unexpectedly increased in certain non-hotspot districts as well. Since NFHS-5 data were collected before the COVID-19 pandemic, the study did not capture its full impact on food security. The authors urged timely policy action to enhance community-based management of malnutrition.

Ganpule *et al.*¹⁸ assessed food insecurity and its determinants in 9,005 North and South Indian adults with the Food Insecurity Experience Scale (FIES). About 10% of the respondents reported experiencing food insecurity between October 2018 and February 2019, and half of them had low dietary diversity (three or fewer food groups per day). Food insecurity was more prevalent in South India, among women, and in the lowest wealth quintile. The report highlighted the need for national policies to improve food security and diet quality, especially among the poor and vulnerable.

Methods

This study employed a graphical approach to investigate the relationship between food security, malnutrition, and obesity in India. Using times

series dataset collected at five-year intervals from 1995 to 2020, sourced from the World Development Indicators (WDI) of the World Bank¹⁹ and the World Health Organization (WHO)²⁰, the research analysed the connections between food availability, accessibility, utilization, malnutrition, and obesity prevalence in India.

Estimation procedures

To analyse the inter-linkage among food security, malnutrition, and obesity in India, this research employed food availability, food accessibility, and food utility as food security indicators, prevalence of undernourishment as an indicator of malnutrition, and prevalence of overweight as an indicator of obesity. The exact measures employed in this research are presented in Table 1. According to the research subject, graphical analysis was chosen as the primary method as it clearly shows trends and patterns, resulting in a good overall understanding of the subject²¹.

Data analysis

For the context of this research, graphical analysis was employed in examining and identifying trends, patterns, and changes within data over time. The use of graphs allows for a lucid and extensive view of the topic of study²⁶⁻³⁰.

Ethical considerations

This study employed anonymized and aggregated statistical information from the World Development Indicators (WDI) and World Health Organization (WHO), which did not involve any risk of harm or revealing identifiable information. No single data were obtained, and the authors adhered meticulously to the use terms set by data providers. The analyses were performed with a methodical, clear, and rigorous process to ensure a clear and accurate reporting of the findings.

Since no animal or human subjects were involved, ethical clearance was not required.

Results

Results of food security and obesity

Figure 1 indicates a gradual rise in the prevalence of obesity (OBS) and food availability (FAV) throughout the period. From 1995 to 2000, obesity increased moderately from 1.2% to 1.8%, and food availability from 55.5 to 62.7. From 2000 to 2005, the trend was rising, with the prevalence of obesity increasing to 2.6%, and food availability to 68.2.

In 2005 to 2010, obesity achieved a higher rise to 3.7%, and food availability increased by leaps and bounds to 84.6. During 2010 to 2015, there was the continued trend when obesity increased to 4.9% and food availability to 98.5. Finally, from 2015 to 2020, there was the highest rise when obesity reached 6.5% and food availability increased to 120.1.

The graph in Figure 2 shows the relationship between food accessibility and obesity in India. The data shows that between 1995 and 2000, the obesity prevalence (OBS) increased slightly from 1.2% to 1.8%, whereas food accessibility (FAC) increased from 2531.9 to 3094.4. Between 2000 and 2005, OBS increased to 2.6%, whereas FAC increased sharply to 3882.09. Between 2005 and 2010, OBS continued its steady increase to 3.7%, whereas FAC increased over 5000 to 5070.9. Between 2010 and 2015, OBS increased further to 4.9%, whereas FAC increased to 6513.4. In 2020, OBS hit a high of 6.5%, while FAC increased to 7432.5.

The Figure 3 showing the relationship between food utility and obesity reveals that between 1995 and 2000, obesity prevalence (OBS) increased slightly from 1.2% to 1.8%, indicating a gradual rise in obesity rates.

Table 1: Measurement of variables

Variable	Code	Measurement	Source	References
Food Availability	FAV	Food security Food Production Index (2014-2016 = 100)	WDI	Shang <i>et al.</i> ²¹
Food Accessibility	FAC	GDP per capita, PPP (constant 2021 international \$)	WDI	Enilolobo <i>et al.</i> ²² Obiakor <i>et al.</i> ²³
Food Utility	FUT	Percentage of population using at least basic drinking water services (per cent)	WDI	Clapp <i>et al.</i> ²⁴
Malnutrition	MNT	Malnutrition Prevalence of undernourishment (% of population)	WDI	Talukdar <i>et al.</i> ²⁵
Obesity	OBS	Percentage of adults aged 18+ with a body mass index of 30 kg/m2 or higher.	WHO	Misra <i>et al.</i> ⁸

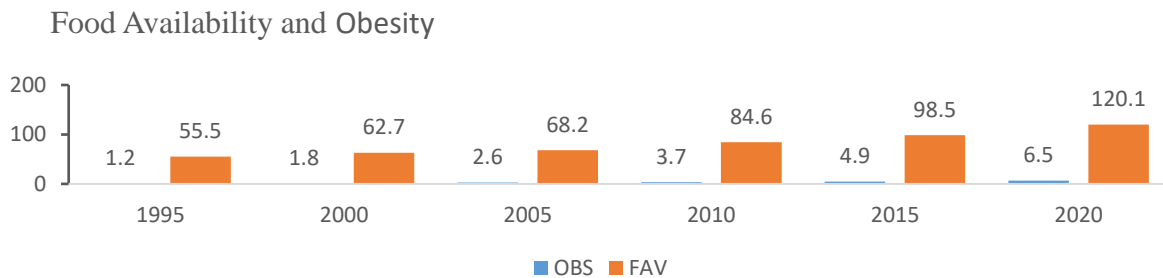


Figure 1: Food availability and obesity in India

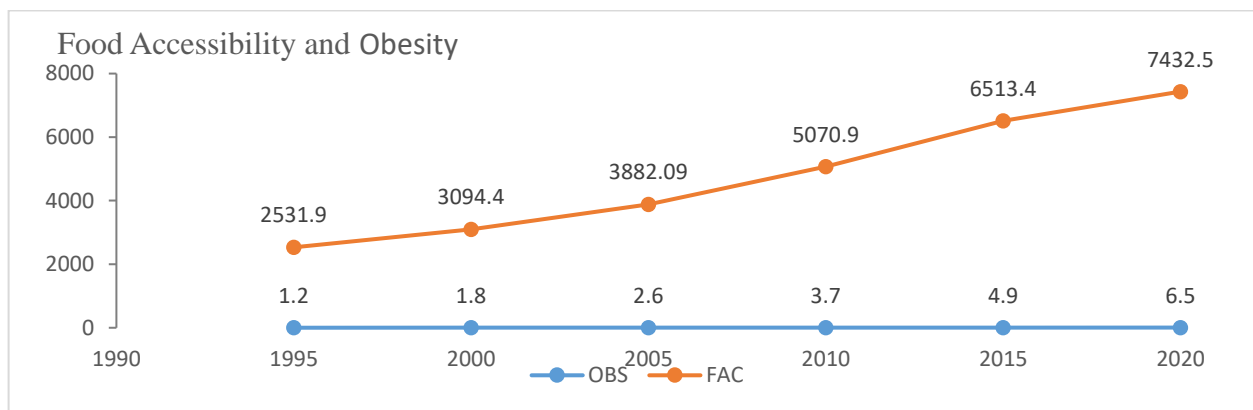


Figure 2: Food accessibility and obesity in India

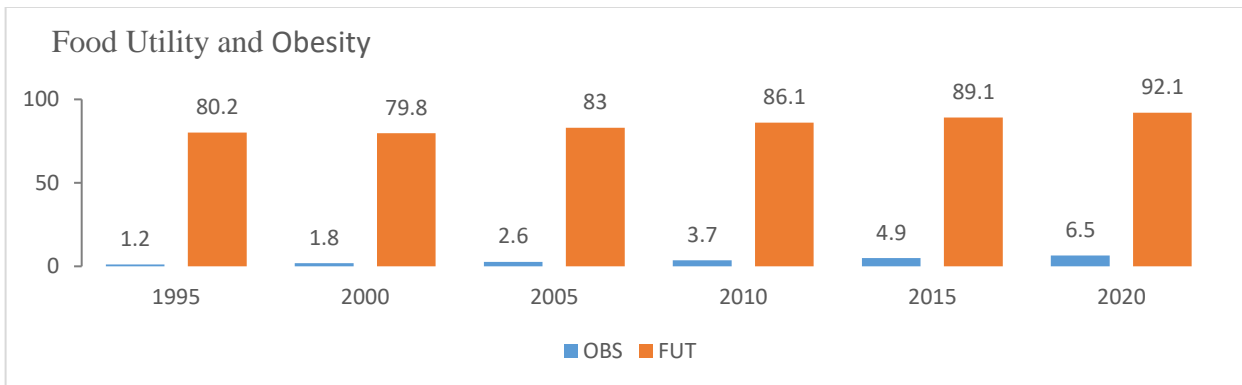


Figure 3: Food utility and obesity in India

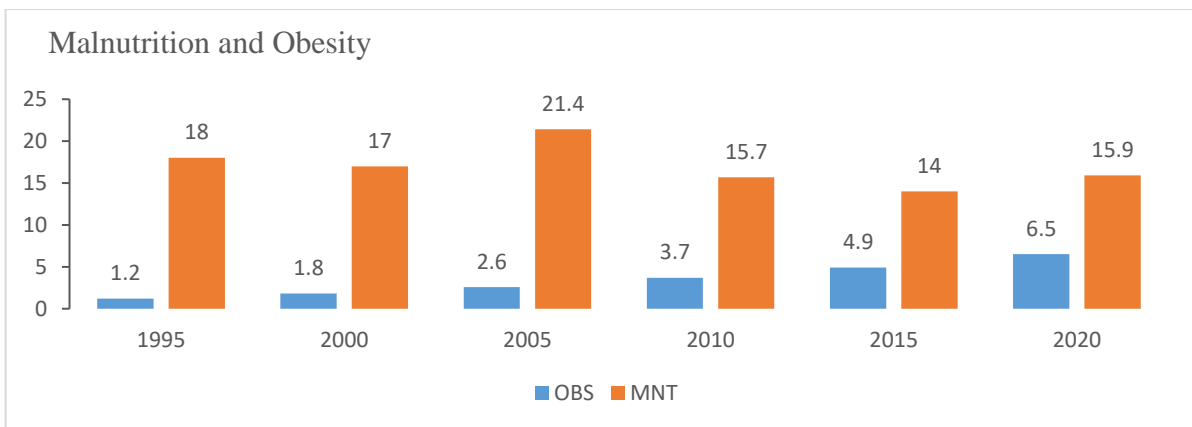


Figure 4: Food utility and obesity in India

Meanwhile, food utility (FUT) experienced a slight decline from 80.2% to 79.8%. From 2000 to 2005, OBS continued its upward trend, reaching 2.6%, while FUT rebounded to 83%. Between 2005 and 2010, OBS climbed further to 3.7%, with FUT increasing to 86.1%. From 2010 to 2015, OBS rose to 4.9%, while FUT improved to 89.1%. By 2020, OBS had reached 6.5%, while FUT stood at 92.1%.

Result of malnutrition and obesity

Figure 4 shows the relationship malnutrition and obesity in a bar chart. Between 1995 and 2000,

there was an increase in obesity prevalence (OBS) from 1.2% to 1.8%, indicating the steady rise of obesity levels. Malnutrition (MNT) decreased slightly from 18% to 17%, indicating an improvement in nutrition and food security at a minute level. From 2000 to 2005, OBS continued to escalate, reaching a level of 2.6%. MNT, on the other hand, showed a sizeable increase from 17% to 21.4%, indicating a deteriorating food security situation despite growing levels of obesity. From 2005-2010, OBS rose to 3.7%, while MNT fell sharply to 15.7%. From 2010-2015, OBS rose again

to 4.9%, while MNT dropped to 14%. By 2020, OBS stood at 6.5%, the highest on record, while MNT rebounded slightly to 15.9%.

Discussion

The rising trend in both obesity and food availability suggests that there is a strong relationship between food production and rising obesity in India. If food availability has increased over the years, obesity has also increased, which means increased access to food does not necessarily mean better diets. Between 1995 and 2005, food availability and obesity rose steadily, most likely due to increased agricultural output and improved food access. Between 2005 and 2010, obesity rose sharply, possibly due to economic development and urbanization, which encouraged a shift towards processed and high-calorie foods. The trend continued between 2010 and 2020, as food availability reached its peak and obesity rose sharply. The correlation between such variables can be explained by modifications in lifestyle and diet. Food availability increases in turn to have more consumption of processed foods, which are easily accessible and cost-effective but are a cause of obesity. Economic growth and urbanization also decrease physical activity, making the condition worse.

The increasing obesity trend along with food availability in India offers evidence of direct correlation between rising economic growth and obesity. As food availability, which is depicted by GDP per capita, increased proportionally from 1995 to 2020 but obesity increased, it substantiates the point that greater economic resources allow individuals to eat more but not necessarily better. Between 1995 and 2005, both variables increased gradually, reflecting improved economic standards and increased purchasing power. However, between 2005 and 2020, obesity rose faster, which correlates with rapid economic growth. This is a

sign of a shift in dietary patterns, where increased consumption of processed foods and foods rich in calories, within affordable means as incomes grow. There is also the input of urbanization and lifestyle change. As there is enhanced access to food, people will eat more convenience foods and have less active lifestyles, which leads to weight gain.

The trend between food utility and obesity in India reveals that with improvements in access to basic drinking water services over the years, the rate of obesity also grew. In the early years, from 1995 to 2000, food utility declined slightly, but obesity increased. Yet, after 2000, food utility steadily improved, in parallel with a steady increase in the prevalence of obesity. The rise in food utility, as reflected by access to clean drinking water, may be a general marker of rises in living standards and sanitation. Better access to water reduces disease from foodborne pathogens and malnutrition, leading to better nutrient absorption and general health, which can lead to weight gain. Moreover, as infrastructure improves, urbanization increases, typically accompanied by more sedentary living and greater intake of processed foods.

The trend from 1995 to 2020 indicates an upward trend in obesity (OBS) and a varying trend in malnutrition (MNT). From 1995 to 2000, although obesity rose, malnutrition slightly declined, showing that food security was improving marginally. From 2000 to 2005, obesity rates increased at an accelerated rate, but there was a spectacular rebound in malnutrition, demonstrating a paradox that food security was worsening despite rising obesity. This may be an indication of an emerging trend of "dual burden malnutrition," where certain populations experience both obesity and malnutrition, often due to poor diet, food insecurity, and limited access to healthy foods. From 2005 to 2015, obesity continued to rise further, reaching a peak in 2020, while malnutrition fell significantly, suggesting that improved access to certain types of food may have helped reduce

malnutrition. However, the growing trend towards obesity could be due to increased consumption of processed and calorie-rich foods, poor diet, and physical inactivity, mainly among urban residents. The slight improvement in malnutrition in 2020, despite growing obesity, could reflect the persistence of underlying disparities in food distribution and access to healthy foods.

Recent evidence supports these findings. Environmental toxins worsen obesity-related metabolic dysfunction, intensifying lipid disorders³¹. Improved stem-cell research also highlights biological pathways linked to adiposity³².

Additionally, macrophage glutamine metabolism has emerged as a crucial regulator of obesity and type-2 diabetes, reinforcing the metabolic complexity underlying rising obesity trends³³.

Study strengths and limitations

This study offers a comprehensive analysis of the interplay between food security, malnutrition, and obesity in India over a 20-year period. The longitudinal approach strengthens the validity of its findings by capturing long-term trends. The use of graphical representations enhances clarity, facilitating trend visualization and comparative analysis. However, there are some important limitations in the research. Its analytical scope remains confined to graphical correlations, thereby omitting other determinants of obesity that could be present, such as education, lifestyle, and genetic disposition. Further, reliance on correlation-based methods rules out causality inference, as observed correlations are not always indicative of direct causality.

Policy implications

Based on the findings, measures to combat India's rising obesity and malnutrition rates must address nutrition and lifestyle. Governments need to run

awareness campaigns among citizens to alert citizens to the risks of eating processed foods and promote healthier consumption habits, mainly in urban areas. Junk food commercials need to be banned, and taxes on foods high in sugar will discourage overconsumption. Increase healthy food availability is critical. Healthy food sources like fruits and vegetables can be made more affordable to buy even to low-income communities through subsidy. Planners should have walkable areas to enhance body activity against sedentary lifestyle. Interventions have to be directed against the double burden of malnutrition and obesity. These include nutrition interventions in vulnerable groups and multi-sectoral healthcare strategies. Strengthening the Public Distribution System (PDS) to carry healthier foods can increase food security. Improved labelling of foods and the elimination of unhealthy ingredients in coordination with the food industry will also help facilitate better consumer choice.

Conclusion

This study has examined the trends of food availability, accessibility, utilization, malnutrition, and obesity in India between 1995 and 2020. The findings reveal a positive correlation between rising food availability and the incidence of obesity, with the incidence of obesity slowly increasing as food availability and access improved. The study establishes that food security has been on the rise over time, particularly in terms of accessibility and utility, but rising consumption of calorie-rich, processed foods has resulted in the rising issue of obesity. The relationship between obesity and malnutrition is complex, with a paradoxical trend of rising levels of nutrition as obesity is on the rise. This suggests that better access to food does not necessarily translate to better diet. The results highlight the need for targeted public health interventions that include raising dietary awareness, regulation of consumption of unhealthy foods, and

improving the supply of foods to address both the twin burdens of obesity and malnutrition among Indians.

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