

Dual Burden of Malnutrition among Older Adults Aged 45 Years and Above in High Burden States in India

Gudakesh Yadav¹, Koustav Ghosh^{2*}, Bijoy Bhattacharjee³, Anshita Sharma⁴

¹ Assistant Professor, Population Research Centre (PRC Baroda), Department of Statistics, The Maharaja Sayajirao University of Baroda, Vadodara-390002, Gujarat, India

² Research Investigator, Population Research Centre (PRC Baroda), Department of Statistics, The Maharaja Sayajirao University of Baroda, Vadodara-390002, Gujarat, India
(ORCID: <https://orcid.org/0000-0002-7085-1885>)

³ Assistant Professor, Department of Geography, The Maharaja Sayajirao University of Baroda, Vadodara-390002, Gujarat, India

⁴ Assistant Professor, Population Research Centre, Mohanlal Sukhadia University, Udaipur, Rajasthan- 313001

Abstract

Background: India faces a dual burden of malnutrition, with undernutrition and overnutrition coexisting in the population. Rapid population ageing makes it crucial to understand the prevalence and determinants of underweight and overweight/obesity among older adults for effective public health planning. This study aims to estimate the prevalence and determinants of underweight and overweight/obesity among older adults in high-burden states in India. **Methodology:** This study utilizes data from Wave 1 (2017-18) of the Longitudinal Ageing Study in India (LASI). Nutritional status was assessed using Body Mass Index and categorized into underweight, normal, and overweight/obese. Two separate dichotomous outcome variables were created for underweight and overweight/obesity. Descriptive statistics were used to estimate prevalence, and binary logistic regression analysis was conducted to identify associated factors. **Results:** At the national level, 21 percent of older adults were underweight, and 28 percent were overweight/obese, indicating a substantial dual burden. Underweight prevalence was particularly high in Chhattisgarh (32%), Odisha (30%), Jharkhand (28%), and Uttar Pradesh (29%). In contrast, overweight/obesity was more prevalent in Punjab (48%), Karnataka (47%), Kerala (46%), and Andhra Pradesh (42%). Logistic regression results revealed that females were less likely to be underweight (AOR=0.77; 95% CI: 0.72-0.81) but significantly more likely to be overweight/obese (AOR=1.88; 95% CI: 1.77-1.99) compared to males. The likelihood of underweight increased significantly with advancing age, whereas the odds of overweight/obesity declined in older age groups. Higher educational attainment showed a protective effect against underweight for ≥ 10 years of schooling but was positively associated with overweight/obesity. Urban residence reduced the likelihood of underweight while significantly increasing the odds of overweight/obesity. Individuals from

*Corresponding Author Email: koustav2020@gmail.com

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the richest quintile had lower odds of underweight but higher odds of overweight/obesity. Conclusion: The findings reveal the need for targeted, region-specific nutrition strategies that simultaneously address both forms of malnutrition in India's ageing population.

Keywords: Dual burden of malnutrition; Underweight; Overweight/Obesity; Older adults; Logistic regression.

Introduction

The burden of malnutrition in any country adversely affects the health and well-being of people in all age groups. The world's biggest causes of death and disability are all linked to malnutrition in one way or another. According to the World Health Organization, malnutrition in all its forms is a major contributor to global morbidity and mortality (WHO, n.d.). Globally, more than 2 billion people are affected by malnutrition, including undernourishment and obesity (Barazzoni & Gortan Cappellari, 2020; Global Nutrition Report, 2020). While much of the global discourse has focused on children and women of reproductive age, the burden among middle-aged and older adults has received comparatively limited attention. Population ageing is accelerating worldwide. Older individuals experience unique nutritional vulnerabilities due to physiological, social, and economic changes. Age-related factors such as reduced appetite, poor dentition, chronic diseases, polypharmacy, and decreased mobility can increase the risk of undernutrition (Evans, 2005; Norman et al., 2021). Undernutrition in later life is associated with frailty, sarcopenia, impaired immunity, delayed wound healing, and increased risk of hospitalization and mortality (Norman et al., 2021). Conversely, overweight and obesity among older adults significantly increase the risk of non-communicable diseases (NCDs) such as diabetes, hypertension, cardiovascular diseases, and osteoporosis (GBD, 2017; Elia, 2015). This simultaneous presence of low body mass index (BMI) and excess weight reflects the broader epidemiological transition occurring in low- and middle-income countries. India presents a complex nutritional landscape characterized by the coexistence of persistent undernutrition and rapidly rising overweight and obesity. The Global Hunger Index ranked India 101 out of 116 countries in 2021, indicating a serious level of hunger and malnutrition (Global Hunger Index, 2021). National surveys show that a considerable proportion of adults are underweight, while overweight and obesity are increasing steadily (Stevens et al., 2012). Findings from the Longitudinal Ageing Study in India (LASI) indicate that 19 percent of females and 23 percent of males aged 45 years and above have low BMI (International Institute for Population Sciences [IIPS], 2020). At the same time, overweight and obesity are becoming more prevalent among middle-aged and older populations, reflecting lifestyle and dietary transitions. High-burden states such as Bihar, Jharkhand, Madhya Pradesh, and Uttar Pradesh continue to face elevated levels of poverty, food insecurity, and limited access to healthcare (World Bank, 2021). These structural disadvantages contribute to chronic undernutrition over the life course. Simultaneously, urbanization and dietary shifts toward energy-dense foods have contributed to rising overweight and obesity, particularly among households in transition economies (Global Nutrition Report, 2020). The coexistence of these contrasting forms of malnutrition within the same geographical regions underscores the urgency of adopting a life-course approach to nutritional assessment. Socioeconomic and demographic factors significantly influence nutritional outcomes among older adults. Education, income, caste,

religion, gender, and access to sanitation facilities are key determinants of malnutrition in India (Singh and Chattopadhyay, 2023; Khan et al., 2023; Ram et al., 2024). Studies have shown that marginalized communities, including Scheduled Castes and Scheduled Tribes, experience disproportionately higher levels of undernutrition (Ram et al., 2024). Women, particularly from disadvantaged backgrounds, are more vulnerable to malnutrition due to gender-based disparities in food allocation, healthcare access, and economic dependency (Saharawat & Sahoo, 2025). Additionally, poor access to safe drinking water and sanitation facilities has been strongly associated with adverse nutritional outcomes (Wolf et al., 2023). The economic implications of malnutrition are substantial. The World Bank estimates that malnutrition costs the global economy approximately 3.5 trillion dollars annually due to increased healthcare expenditures, lost productivity, and reduced economic growth (World Bank, 2021). In ageing populations, malnutrition further exacerbates healthcare burdens by increasing the prevalence of chronic diseases and functional disabilities. Addressing the dual burden among individuals aged 45 years and above is therefore critical not only from a public health perspective but also from an economic and social standpoint. India has implemented several large-scale nutrition and food security programs, including the National Food Security Act, Poshan Abhiyaan, and other targeted schemes (NITI Aayog, 2019; National Statistical Office, 2021). However, these programs have primarily focused on maternal and child health. Nutritional interventions specifically targeting middle-aged and older adults remain limited. As India progresses toward achieving the Sustainable Development Goals, particularly SDG 2 (Zero Hunger) and SDG 3 (Good Health and Well-being) (Sachs et al., 2022), it is essential to expand the scope of nutrition policies to include ageing populations. Given the demographic transition, persistent socioeconomic inequalities, and ongoing nutritional transition in high-burden states, there is a pressing need to generate evidence on the prevalence and determinants of the dual burden of malnutrition among individuals aged 45 years and above. Understanding how underweight and overweight coexist within this age group, and how these patterns vary across socioeconomic and demographic characteristics, can inform targeted and context-specific interventions. Such evidence is essential for designing inclusive policies that promote healthy ageing and reduce nutritional inequalities in India.

In this context, the present study examines the dual burden of malnutrition among individuals aged 45 years and above in selected high-burden states of India. By focusing on older adults, the study aims to contribute to a more comprehensive understanding of malnutrition beyond early life stages and to support evidence-based policy formulation for promoting healthy and dignified ageing in India.

Data and Methods

Data Source

The current research relies on data from the Longitudinal Ageing Study in India (LASI), a large, nationally representative survey that examines the health, social, and economic status of India's ageing population. The implementation of LASI is done under the leadership of the Ministry of Health and Family Welfare, Government of India, in cooperation with the International Institute of Population Sciences (IIPS), Mumbai, and Harvard T.H. Chan School

of Public Health, the University of Southern California, and the University of California, San Francisco. The LASI Wave 1 began in 2016, and the fieldwork was carried out in 2017-18. The survey uses a multistage, stratified, area-probability, cluster sampling design, which will provide reliable estimates at both the national and state levels. In the current research, the analytical sample is limited to participants aged 45 years and above, with full information on the selected outcome and explanatory variables. It uses appropriate sampling weights provided by LASI to compensate for the complex survey design and generate population-level estimates.

Outcome and Output variables

Dependent variable: The BMI of individuals aged 45 years and older was used to determine nutritional status, based on measured height and weight available in the LASI dataset. BMI was categorized according to adult standard cut-offs. Patients with a BMI of less than 18.5 kg/m² were classified as underweight, a BMI of 18.5 to 24.9 kg/m² as normal, and a BMI of 25.0 kg/m² or higher as overweight/obese. For analytical purposes, two separate dichotomous variables were created. In the first model, underweight was coded as “1” for individuals with BMI <18.5 kg/m² and “0” for those with BMI ≥18.5 kg/m². In the second model, overweight/obese was coded as “1” for individuals with BMI ≥25.0 kg/m² and “0” for those with BMI <25.0 kg/m².

Independent Variable: A set of independent variables used in the study. It includes Gender (male/female), age of the respondents (45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, and 80 years and above), Marital status (currently married/in union and not in union), Educational attainment (no education, less than 5 years, 5-9 years, and 10 or more years of schooling), living arrangement (living alone or with others and those living with family members), work status (currently working/currently non-working), Religion (Hindu, Muslim, Christian, and others), caste (Scheduled Castes/Scheduled Tribes/Other Backward Classes/ and Other castes). Place of residence (rural and urban), economic status (poorest, poorer, middle, richer, and richest), and region of residence (Northern, Central, North-eastern, Eastern, Western, and Southern).

Statistical Analysis

Appropriate bivariate and multivariate regression analyses have been used to examine the level and change in children's nutritional status under age six. The binary logistic regression model has been used to analyse the adjusted effects of various predictors of stunting, wasting, underweight, and overweight or obesity. The Logistic Regression Model is commonly estimated by the maximum likelihood function. For the outcome variable, the logistic model takes the following general form:

$$\text{Logit}(P) = \ln\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \dots + \beta_iX_i$$

Where P is the probability of the outcome. The β_1 , β_2 , β_3 , and β_i represent the coefficients of each of the predictor variables included in the model. $\ln(P/1-P)$ represents the natural logarithm of the odds of the outcome.

Results

Nutritional Status of people aged 45 and above in India

Table 1 presents the prevalence of underweight and overweight/obesity among older adults across states and UTs of India based on LASI Wave 1 (2017-18). At the national level, 20.6 percent of older adults are underweight, while 28 percent are overweight or obese, indicating the coexistence of undernutrition and overnutrition among the elderly population. The highest prevalence of underweight is observed in Chhattisgarh (32.3%), followed by Odisha (30.0%), Dadra & Nagar Haveli (29.5%), Uttar Pradesh (29.0%), and Jharkhand (28.4%). In contrast, the lowest prevalence is reported in Chandigarh (4.6%), followed by Delhi (5.4%) and Kerala (5.4%). A total of 12 states/UTs have underweight prevalence higher than the national average (20.6%). These are Rajasthan, Uttar Pradesh, Bihar, Tripura, Meghalaya, Assam, West Bengal, Jharkhand, Odisha, Chhattisgarh, Madhya Pradesh, and Dadra & Nagar Haveli. These states are largely concentrated in the central, eastern, and some northeastern regions, reflecting continued nutritional deprivation among older adults. On the other hand, The highest prevalence of overweight/obesity is found in Chandigarh (55.4%), followed by Delhi (53.1%), Punjab (48.0%), Karnataka (46.6%), Daman & Diu (46.1%), and Kerala (45.6%). The lowest prevalence is seen in Meghalaya (12.8%), followed by Chhattisgarh (15.0%) and Assam (15.7%). Overall, 16 states/UTs report overweight/obesity prevalence above the national average (28.0%). These are Jammu & Kashmir, Himachal Pradesh, Punjab, Chandigarh, Delhi, Manipur, Gujarat, Daman & Diu, Maharashtra, Andhra Pradesh, Karnataka, Goa, Lakshadweep, Kerala, Puducherry, and Andaman & Nicobar Islands.

Table 1: Prevalence of underweight, overweight, and obesity among older adults, states/UTs, LASI Wave 1, 2017-18

States/UTs	Normal	Underweight	Overweight/Obese
Jammu & Kashmir	49.9	10.8	39.3
Himachal Pradesh	47.0	11.2	41.8
Punjab	43.2	8.8	48.0
Chandigarh	40.1	4.6	55.4
Uttarakhand	54.6	18.7	26.8
Haryana	52.2	18.5	29.3
Delhi	41.5	5.4	53.1
Rajasthan	56.0	22.8	21.2
Uttar Pradesh	51.4	29.0	19.7
Bihar	56.2	25.0	18.8
Arunachal Pradesh	63.6	7.6	28.8

Nagaland	71.4	8.6	20.0
Manipur	51.3	11.1	37.6
Mizoram	65.4	12.6	22.1
Tripura	53.5	27.9	18.6
Meghalaya	66.9	20.3	12.8
Assam	59.4	24.9	15.7
West Bengal	54.8	24.4	20.8
Jharkhand	55.4	28.4	16.2
Odisha	51.9	30.0	18.1
Chhattisgarh	52.7	32.3	15.0
Madhya Pradesh	53.8	26.9	19.3
Gujarat	49.0	17.8	33.2
Daman & Diu	43.2	10.7	46.1
Dadra & Nagar Haveli	48.1	29.5	22.4
Maharashtra	51.2	16.5	32.3
Andhra Pradesh	46.2	11.5	42.3
Karnataka	40.3	13.1	46.6
Goa	50.3	11.5	38.2
Lakshadweep	51.3	7.1	41.6
Kerala	49.0	5.4	45.6
Tamil Nadu	51.4	13.9	34.8
Puducherry	47.6	8.4	43.9
Andaman & Nicobar Islands	50.2	10.5	39.3
Telangana	51.4	17.5	31.2
Total	51.3	20.6	28.0

Spatial Prevalence of malnutrition in high-burden states in India

The map illustrates the state-wise distribution of the double burden of malnutrition in India, highlighting states with high prevalence of underweight and overweight/obesity. The central

and eastern states such as Chhattisgarh (32.3%), Odisha (30%), Jharkhand (28.4%), and Uttar Pradesh (29%) show a higher prevalence of underweight. These states form a cluster in the central-eastern region. In contrast, southern and north-western states such as Punjab (48%), Karnataka (46.6%), Kerala (45.6%), and Andhra Pradesh (42.3%) exhibit a higher prevalence of overweight and obesity.

Figure 1: State-wise Distribution of Underweight, Normal, and Overweight/Obesity among Older Adults Aged 45 Years and Above in India, LASI Wave 1 (2017-18)

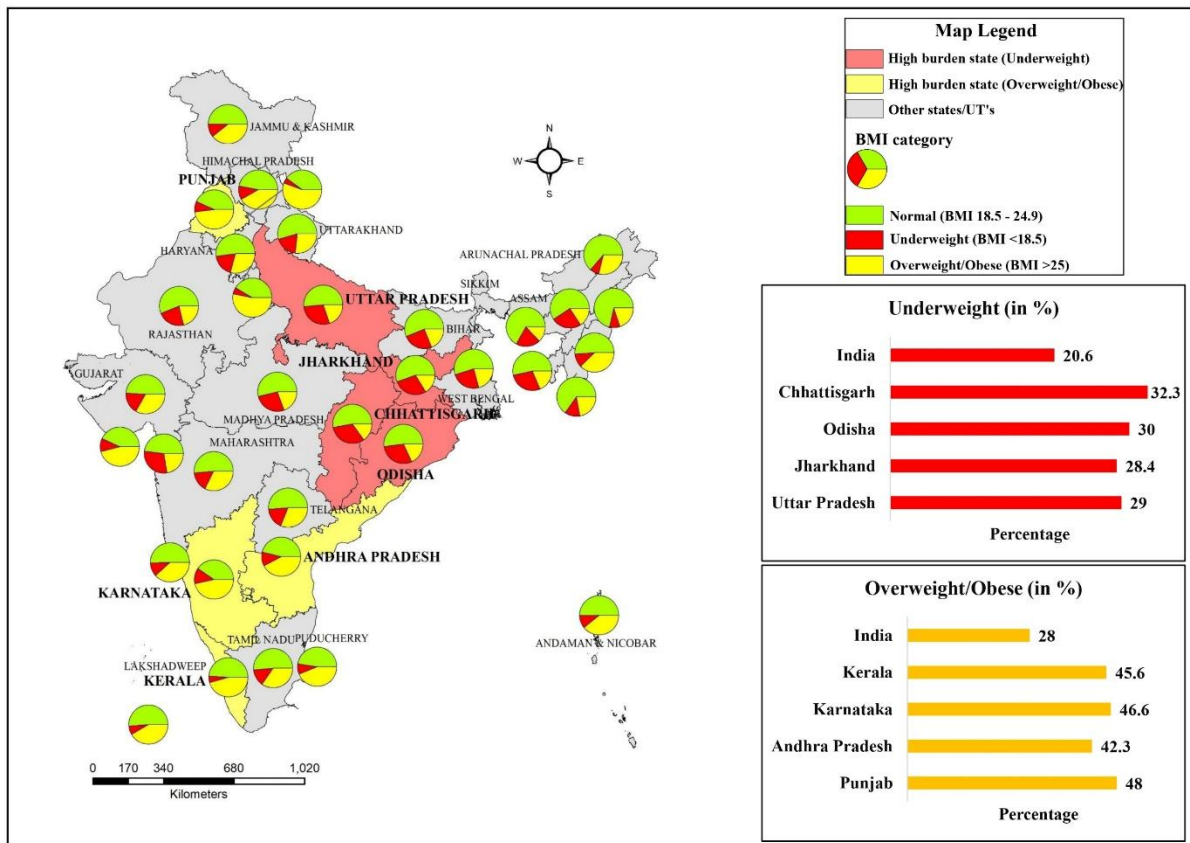


Table 2 shows the prevalence of normal BMI, underweight, overweight, and obesity among older adults according to different background characteristics. The prevalence of underweight varies significantly by background characteristics. Males are more likely to be underweight (22.6%) than females (19.2%), and underweight is more common as people get older, with the highest prevalence among people 80 and older (39.8%). Compared with older adults who are currently married or in a union (18.4%), those who are not in a union are more likely to be overweight (28.1%). With higher levels of education, the prevalence of low BMI declines. The prevalence of underweight is highest among those with no education (27.5%) and lowest among those with ten or more years of education (7.9%). In comparison to older adults living with family members (19.8%), those who live alone or with others are more likely to be underweight (31.4%). Adults who are currently employed have a lower prevalence of being underweight (20.3%) than those who are not employed (25.5%). The prevalence of underweight is similar among all religious groups, with Christians having the highest rate (23.7%) and Muslims having the lowest (18.2%). The Scheduled Tribes have the highest rate of underweight (33.9%), and the Other Castes have the lowest rate (14.9%). Compared to older

adults living in urban areas (9.2%), those living in rural areas are more likely to be underweight (25.6%). Being Underweight is less common as wealth increases, with the Poorest having the highest prevalence (27.6%) and the Richest having the lowest (11.2%). The Southern region has the lowest prevalence of underweight (21.9%), and the Central region has the highest prevalence (28.6%).

The prevalence of overweight/obesity among older adults is relatively high and varies significantly depending on background characteristics. According to the table, women are more likely than men to be overweight or obese (32.8% and 21.4% respectively). In addition, the prevalence of overweight and obesity rises with age until age 50 to 54 (33.4%), at which point it begins to decline. Urban dwellers (46.5%) and those with ten or more years of education (46.4%) have the highest rates of overweight/obesity. Additionally, more people who are currently married or in a union (29.4%), Muslims (31.4%), and people who fall under the "Other Castes" category (34.9%) are overweight or obese.

Living with family members is associated with a higher prevalence of overweight/obesity (28.7%) than living alone (19.3%), regardless of living situation. The prevalence of overweight/obesity does not appear to be significantly impacted by work status, as there is little difference between those who work (24%) and those who do not (24.2%). Hindus, compared to Christians (24.6%) and Muslims (31.4%), have a lower prevalence of overweight/obesity (27.3%). Scheduled Tribes (12.7%) have the lowest prevalence of overweight/obesity, and "Others" (37.5%) have the highest. Last but not least, the prevalence of overweight/obesity is lowest (19.2%) and highest (41.3%) in the richest quintile. The Southern region, followed by the Northern (33.1%) and Western (32.6%) regions, has the highest prevalence of overweight/obesity (40.6%). Prevalence rates in the Central, north-eastern, and Eastern regions range from 18.4% to 19.2%.

Table 2: Prevalence of underweight, overweight, and obesity among older adults by background characteristics, LASI Wave 1, 2017-18

Socio-Economic Characteristics	Normal	Underweight	Overweight/Obese
Gender			
Male	56	22.6	21.4
Female	48	19.2	32.8
Age (in years)			
45-49	52.5	15.3	32.2
50-54	51.5	15.1	33.4
55-59	51.5	18.2	30.3
60-64	50.3	23.1	26.6

Socio-Economic Characteristics	Normal	Underweight	Overweight/Obese
65-69	51.6	24	24.4
70-74	52.3	27.4	20.3
75-79	55	30.5	14.4
80+	46.3	39.8	14
Marital Status			
currently married/in	52.2	18.4	29.4
not in union	48.3	28.1	23.6
Education			
No education	53	27.5	19.6
Less than 5 years	53.8	21.8	24.4
5-9 years	51	14.9	34.2
10 or more years	45.7	7.9	46.4
Living arrangement			
Living alone or with others	49.3	31.4	19.3
Living with family members	51.5	19.8	28.7
Work status			
Yes	55.8	20.3	24
No	50.3	25.5	24.2
Religion			
Hindu	51.6	21.1	27.3
Muslim	50.4	18.2	31.4
Christian	51.7	23.7	24.6
Others	47.8	14.7	37.5
Caste			
Scheduled Castes	53.7	25.5	20.9
Scheduled Tribes	53.5	33.9	12.7

Socio-Economic Characteristics	Normal	Underweight	Overweight/Obese
Other Backward Class	50.5	19.3	30.2
Other Castes	50.2	14.9	34.9
Residence			
Rural	54.4	25.6	19.9
Urban	44.3	9.2	46.5
Wealth Quintile			
Poorest	53.2	27.6	19.2
Poorer	52.3	24.3	23.4
Middle	52.2	21.1	26.7
Richer	50.9	17.2	31.8
Richest	47.5	11.2	41.3
Region of Residence			
Northern	50.8	16.2	33.1
Central	52.3	28.6	19.1
North-eastern	59.4	22.2	18.4
Eastern	54.9	26	19.2
Western	50.5	16.9	32.6
Southern	46.5	12.9	40.6
Total	51.3	20.6	28

Determinants of underweight, overweight, and obesity among older adults (45 and above)

Determinants of Underweight among Table 3 presents the results of the logistic regression model used to determine the determinants of underweight among older adults in India and in the selected states (Odisha, Jharkhand, Chhattisgarh, and Uttar Pradesh). The national level shows that sex has a significant relationship with underweight. In India (AOR = 0.77; 95% CI: 0.72-0.81) and in Uttar Pradesh (AOR = 0.63; 95% CI: 0.51-0.78), females have much lower odds of being underweight than males. Nonetheless, this association is not statistically significant in Jharkhand (AOR = 1.04; 95% CI: 0.79-1.37) and Chhattisgarh (AOR = 1.04; 95% CI: 0.79-1.37), indicating a state-specific association. Underweight is closely and positively associated with age. In comparison to the adults (45-49 years of age), the risk of

underweight with increasing age is increasing steadily in India: 50-54 years (AOR = 1.11; 95% CI: 1.02-1.22), 55-59 years (AOR = 1.22; 95% CI: 1.11-1.34), 60-64 years (AOR = 1.45; 95% CI: 1.32-1.58) The same increasing age grading is seen among the states, with the highest odds observed with the oldest-old in Odisha (AOR = 5.75; 95% CI: 2.39-3.12), in Jharkhand (AOR = 3.16; 95% CI: 1.72-5.80) and Uttar Pradesh (AOR = 2.12; 95% CI: 1.34-3.37). Underweight is also strongly associated with marital status. In India (AOR = 1.27; 95% CI: 1.18-1.36) and Jharkhand (AOR = 1.41; 95% CI: 1.02-1.94), the odds of underweight older adults who are not in union are higher, although the association is not significant in Uttar Pradesh (AOR = 1.20; 95% CI: 0.94-1.53). There is a strong protective effect of educational attainment. The odds of underweight are lower among individuals with less than 5 years (AOR = 0.81; 95% CI: 0.75-0.87), 5-9 years old (AOR = 0.63; 95% CI: 0.58-0.67), and 10 or more years (AOR = 0.35; 95% CI: 0.31-0.38) of schooling in India. This is also similar to Jharkhand (AOR = 0.43; 95% CI: 0.26-0.68) and Uttar Pradesh (AOR = 0.38; 95% CI: 0.28-0.51). In India, the living arrangement and work status do not significantly relate to underweight, but the odds ratios are close to unity, indicating that there is a close relationship between living with family members (AOR = 0.99; 95% CI: 0.89-1.09) and not working (AOR = 1.02; 95% CI: 0.96-1.08). There are similar non-significant trends in most states. Differentials based on religion are observed. In India, Muslims have considerably lower odds of being underweight than Hindus (AOR = 0.72; 95% CI: 0.65-0.80) and in Odisha (AOR = 0.54; 95% CI: 0.65-0.80). Even in India (OR = 0.40; 95% CI: 0.36-0.44) and Jharkhand (AOR = 0.48; 95% CI: 0.26-0.88), the odds among Christians are even lower. Nonetheless, estimates for the 'Others' category are not particularly consistent across states. Disparities in castes exist. Indian Scheduled Tribes are much more likely than Scheduled Castes to be underweight (AOR = 1.34; 95% CI: 1.23-1.45) and in Odisha (AOR = 1.41; 95% CI: 1.23-1.45). Other Backward Classes (AOR = 0.85; 95% CI: 0.80-0.91) and Other Castes (AOR = 0.73; 95% CI: 0.66-0.79) are significantly low in India. The place of residence becomes an influential determinant. In India, urban dwelling older adults are much less at risk of being underweight as compared to rural dwelling older adults (AOR = 0.43; 95% CI: 0.40-0.46), with comparable protective effect in Odisha (AOR = 0.51; 95% CI: 0.40-0.46), Jharkhand (AOR = 0.27; 95% CI: 0.16-0.44), Chhattisgarh (AOR = 0.27; 95% CI: 0.16-0.44), and Uttar Pradesh (AOR = 0.50; 95% CI: 0.38-0.66). There is an inverse gradient with regard to wealth status. Compared with the poorest group, the odds of underweight decrease progressively across wealth quintiles in India, with the lowest among the richest (AOR = 0.46; 95% CI: 0.42-0.50). The same decline is observed in Jharkhand (AOR = 0.40; 95% CI: 0.22-0.71) and Uttar Pradesh (AOR = 0.64; 95% CI: 0.47-0.88). The results show that underweight among the elderly in India is closely related to the age of individuals, disruption in the marital status, socioeconomic disadvantage, rural factors, and caste-based inequity, with diverse penetration levels in different states.

Table 3: Results of Logistic Regression showing the determinants of underweight among older adults (45 and above years) in India, 2017-18

Socio-Economic Characteristics	India AOR (95% CI)	Odisha AOR (95% CI)	Jharkhand AOR (95% CI)	Chhattisgarh AOR (95% CI)	Uttar Pradesh AOR (95% CI)
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Gender					
Male®					
Female	0.765***(0.72, 0.81)	1.355***(0.72, 0.81)	1.042(0.79, 1.37)	1.042(0.79, 1.37)	0.63***(0.51, 0.78)
Age (In Years)					
45-49®					
50-54	1.113**(1.02, 1.22)	1.101**(1.02, 1.22)	1.217(0.8, 1.86)	1.217(0.8, 1.86)	1.074(0.79, 1.47)
55-59	1.219***(1.11, 1.34)	1.215***(1.11, 1.34)	1.212(0.78, 1.87)	1.212(0.78, 1.87)	1.014(0.74, 1.39)
60-64	1.445***(1.32, 1.58)	1.388***(1.32, 1.58)	1.282(0.86, 1.91)	1.282(0.86, 1.91)	1.501***(1.1, 2.04)
65-69	1.604***(1.46, 1.76)	1.561***(1.46, 1.76)	1.649**(1.05, 2.59)	1.649**(1.05, 2.59)	1.627***(1.18, 2.23)
70-74	1.888***(1.7, 2.1)	2.006***(1.7, 2.1)	1.528*(0.93, 2.51)	1.528*(0.93, 2.51)	1.635***(1.14, 2.34)
75-79	2.159***(1.9, 2.45)	1.418***(1.9, 2.45)	3.421***(1.88, 6.22)	3.421***(1.88, 6.22)	2.716***(1.74, 4.24)
80+	2.731***(2.39, 3.12)	5.747***(2.39, 3.12)	3.158***(1.72, 5.8)	3.158***(1.72, 5.8)	2.124***(1.34, 3.37)
Marital Status					
currently married/in union®					
not in union	1.27***(1.18, 1.36)	1.132***(1.18, 1.36)	1.407**(1.02, 1.94)	1.407**(1.02, 1.94)	1.203(0.94, 1.53)
Education					
No education®					
Less than 5 years	0.808***(0.75, 0.87)	1.23***(0.75, 0.87)	0.661*(0.44, 1)	0.661*(0.44, 1)	0.919(0.65, 1.3)
5-9 years	0.625***(0.58, 0.67)	1.071***(0.58, 0.67)	0.661**(0.47, 0.93)	0.661**(0.47, 0.93)	0.634***(0.5, 0.81)
10 or more years	0.348***(0.31, 0.38)	0.508***(0.31, 0.38)	0.425***(0.26, 0.68)	0.425***(0.26, 0.68)	0.382***(0.28, 0.51)
Living arrangement					
Living alone or with others					
Living with family members	0.988(0.89, 1.09)	1.021(0.89, 1.09)	0.916(0.54, 1.55)	0.916(0.54, 1.55)	1.321(0.91, 1.93)
Work status					

Yes®					
No	1.017(0.96, 1.08)	0.973(0.96, 1.08)	1.044(0.79, 1.38)	1.044(0.79, 1.38)	1.064(0.86, 1.31)
Religion					
Hindu®					
Muslim	0.721***(0.65, 0.8)	0.541***(0.65, 0.8)	0.666**(0.45, 1)	0.666**(0.45, 1)	0.843(0.63, 1.13)
Christian	0.397***(0.36, 0.44)	0.815***(0.36, 0.44)	0.48**(0.26, 0.88)	0.48**(0.26, 0.88)	-
Others	0.63***(0.55, 0.73)	-	0.788(0.42, 1.48)	0.788(0.42, 1.48)	1.589(0.51, 4.94)
Caste					
Scheduled Castes®					
Scheduled Tribes	1.338***(1.23, 1.45)	1.406***(1.23, 1.45)	1.362(0.88, 2.11)	1.362(0.88, 2.11)	0.911(0.51, 1.63)
Other Backward Class	0.854***(0.8, 0.91)	0.585***(0.8, 0.91)	1.168(0.81, 1.67)	1.168(0.81, 1.67)	0.772**(0.63, 0.95)
Other Castes	0.725***(0.66, 0.79)	0.518***(0.66, 0.79)	0.614*(0.36, 1.06)	0.614*(0.36, 1.06)	0.66***(0.51, 0.86)
Residence					
Rural®					
Urban	0.425***(0.4, 0.46)	0.506***(0.4, 0.46)	0.27***(0.16, 0.44)	0.27***(0.16, 0.44)	0.5***(0.38, 0.66)
Wealth Quintile					
Poorest®					
Poorer	0.893***(0.83, 0.96)	0.797***(0.83, 0.96)	0.933(0.69, 1.26)	0.933(0.69, 1.26)	0.827(0.65, 1.04)
Middle	0.722***(0.67, 0.78)	0.696***(0.67, 0.78)	0.612***(0.44, 0.85)	0.612***(0.44, 0.85)	0.886(0.69, 1.13)
Richer	0.579***(0.54, 0.63)	0.482***(0.54, 0.63)	0.594***(0.41, 0.85)	0.594***(0.41, 0.85)	0.771*(0.58, 1.03)
Richest	0.461***(0.42, 0.5)	0.472***(0.42, 0.5)	0.399***(0.22, 0.71)	0.399***(0.22, 0.71)	0.643***(0.47, 0.88)

*Note: AOR: Adjusted Odds Ratio; ®Reference category; Level of Significant
*** $P < 0.001$, ** $P < 0.01$, * $P < 0.05$*

Table 4 presents the results of a logistic regression model examining factors associated with overweight and obesity among the older adult population in India and the selected states (Punjab, Karnataka, Kerala, and Andhra Pradesh). Sex is also largely correlated with

overweight/obesity, where females are immensely more likely to be overweight/obese than males in India in general (AOR = 1.88; 95% CI: 1.77-1.99). The same trend can be seen in Punjab (AOR = 2.08; 95% CI: 1.41-3.07), Karnataka (AOR = 1.78; 95% CI: 1.33-2.38), Kerala (OR = 2.12; 95% CI: 1.56-2.87), and Andhra Pradesh (OR = 1.43; 95% CI: 1.10-1.86), which implies that gender is an important determinant of overweight/obese. It is negatively correlated with age. The risk of overweight or obesity is lower at older ages in India especially among those aged 60-64 years (AOR = 0.80; 95% CI: 0.74-0.87), 70-74 years (AOR = 0.55; 95% CI: 0.49-0.61) and 80 years and over (AOR = 0.36; 95% CI: 0.30-0.42). Though the trend is roughly the same across states, the strength of the age effect varies by region. These results indicate that old age is associated with a lower risk of excess weight in later life. There is a low level of association between marital status. Among older adults in union, those who are not married are somewhat less likely to be overweight/obese than those who are currently married (AOR = 0.92; 95% CI: 0.86-0.99), but the association is not significant in most states. Education level is a powerful determinant. In India, the odds of overweight/obesity are increasing with the years of schooling; less than five years (AOR = 1.33; 95% CI: 1.22-1.44), 5 to 9 years (AOR = 1.74; 95% CI: 1.62-1.86), and ten or more years of schooling (OR = 2.40; 95% CI: 2.23-2.59) demonstrate this tendency in comparison with 0 years of school. This educational advantageous gradient is also outstanding in Karnataka (AOR = 2.20; 95% CI: 1.49-2.324) and, in specific Kerala (AOR = 3.09; 95% CI: 1.74-5.52). There are also living arrangements and work status that affect overweight/obesity. Indians who are aged with family members have increased chances of overweight/obesity (AOR = 1.27; 95% CI: 1.14-1.42), but the effect is very strong in Kerala (AOR = 2.46; 95% CI: 1.33-4.54). On the same note, non-current workers have higher odds than current workers (India OR = 1.29; 95% CI: 1.21-1.36; Andhra Pradesh (AOR = 1.62; 95% CI: 1.25-2.09), though the association is less significant in some states. Religious differentials are also apparent, but not consistent. Among the Indians, Muslims (AOR = 1.31; 95% CI: 1.21-1.43), Christians (AOR = 1.25; 95% CI: 1.14-1.38), and other religious persons (AOR = 1.66; 95% CI: 1.48-1.86) demonstrate higher odds of being overweight/obese compared to Hindus. Inequality in terms of caste still exists. Scheduled Tribes are much less likely to have odds compared to Scheduled Castes in India (AOR = 0.64; 95% CI: 0.58-1.07) and Andhra Pradesh (OR = 0.30; 95% CI: 0.1755), but Other Backward Classes (AOR = 1.16; 95% CI: 1.09-1.25) and Other Castes (AOR = 1.32; 95% CI: 1.22-1.43). The place of residence becomes one of the key predictors. The likelihood of older people living in urban areas being overweight or obese is more than twice as high among rural residents in India (AOR = 2.33; 95% CI: 2.21-2.45). Karnataka (AOR = 2.18; 95% CI: 1.65-2.88), Kerala (AOR = 1.44; 95% CI: 1.11-1.86), and Andhra Pradesh are also found to have this increased urban risk (AOR = 1.50; 95% CI: 1.14-1.98). Also, there is a definite positive gradient in wealth status. In India, the probability of overweight/obesity increases gradually across wealth quintiles, with the highest probability among the wealthiest (AOR = 2.27; 95% CI: 2.09-2.46). The same pattern of increase is witnessed in Kerala (AOR = 1.92; 95% CI: 1.24-2.96) and Andhra Pradesh (AOR = 1.77; 95% CI: 1.20-2.60). It suggests that socioeconomic advantage, the rural population, and the female gender have a strong correlation with overweight and obesity among older adults in India, but the strength of the effects differs across state

Table 4: Results of Logistic Regression showing the determinants of Overweight/Obese among older adults (45 and above years) in India, 2017-18

Socio-Economic Characteristics	India AOR (95% CI)	Punjab AOR (95% CI)	Karnataka AOR (95% CI)	Kerala AOR (95% CI)	Andhra Pradesh AOR (95% CI)
Gender					
Male®					
Female	1.881***(1.77, 1.99)	2.082***(1.41, 3.07)	1.781***(1.33, 2.38)	2.115***(1.56, 2.87)	1.431***(1.1, 1.86)
Age (In Years)					
45-49®					
50-54	1.051(0.98, 1.13)	0.928(0.6, 1.45)	0.947(0.66, 1.36)	1.118(0.73, 1.7)	1.167(0.84, 1.63)
55-59	0.956(0.88, 1.03)	1.232(0.76, 1.99)	0.743(0.49, 1.12)	1.004(0.65, 1.56)	0.836(0.59, 1.18)
60-64	0.802***(0.74, 0.87)	1.032(0.63, 1.69)	0.821(0.55, 1.23)	0.891(0.56, 1.41)	0.669**(0.47, 0.95)
65-69	0.69***(0.63, 0.75)	0.649*(0.4, 1.06)	0.894(0.6, 1.34)	1.208(0.75, 1.94)	0.558***(0.38, 0.82)
70-74	0.548***(0.49, 0.61)	0.462**(0.26, 0.83)	0.532**(0.3, 0.93)	0.785(0.45, 1.38)	0.365***(0.22, 0.61)
75-79	0.421***(0.37, 0.49)	0.391**(0.18, 0.83)	0.399***(0.21, 0.77)	0.711(0.37, 1.36)	0.302***(0.15, 0.61)
80+	0.358***(0.3, 0.42)	0.235***(0.09, 0.61)	0.305***(0.12, 0.75)	0.477*(0.22, 1.05)	0.201***(0.09, 0.44)
Marital Status					
currently married/in®					
not in union	0.922**(0.86, 0.99)	0.891(0.58, 1.36)	0.747(0.52, 1.07)	1.273(0.82, 1.98)	1.044(0.75, 1.44)
Education					
No education®					
Less than 5 years	1.325***(1.22, 1.44)	1.589(0.91, 2.79)	1.129(0.8, 1.6)	1.468(0.82, 2.63)	1.504**(1.02, 2.22)
5-9 years	1.736***(1.62, 1.86)	1.203(0.84, 1.73)	1.833***(1.3, 2.59)	1.573(0.89, 2.78)	1.598***(1.17, 2.18)
10 or more years	2.403***(2.23, 2.59)	1.328(0.88, 2)	2.201***(1.49, 3.24)	3.097***(1.74, 5.52)	1.931***(1.33, 2.79)

Living arrangement					
Living alone or with others®					
Living with family members	1.273***(1.14, 1.42)	1.082(0.53, 2.2)	0.705(0.41, 1.21)	2.456***(1.33, 4.54)	1.439(0.91, 2.27)
Work status					
Yes®					
No	1.285***(1.21, 1.36)	1.302(0.92, 1.84)	1.307*(0.98, 1.75)	0.921(0.69, 1.24)	1.619***(1.25, 2.09)
Religion					
Hindu®					
Muslim	1.313***(1.21, 1.43)	0.252(0.03, 2.22)	1.376*(0.95, 2)	1.596**(1.09, 2.33)	2.213***(1.37, 3.58)
Christian	1.252***(1.14, 1.38)	4.493(0.39, 51.95)	1***(0, 0)	0.956(0.68, 1.35)	0.769(0.54, 1.09)
Others	1.658***(1.48, 1.86)	1.087(0.77, 1.54)	0.586(0.15, 2.37)	0***(0, 0)	
Caste					
Scheduled Castes®					
Scheduled Tribes	0.64***(0.58, 0.7)	2.439*(0.84, 7.06)	0.412*(0.16, 1.04)	1.008(0.4, 2.52)	0.304***(0.17, 0.55)
Other Backward Class	1.166***(1.09, 1.25)	1.155(0.76, 1.75)	1.283(0.86, 1.9)	0.905(0.58, 1.42)	0.854(0.64, 1.14)
Other Castes	1.322***(1.22, 1.43)	1.785***(1.25, 2.55)	1.678**(1.01, 2.78)	0.946(0.58, 1.55)	1.339(0.93, 1.93)
Residence					
Rural®					
Urban	2.325***(2.21, 2.45)	1.36*(0.95, 1.94)	2.178***(1.65, 2.88)	1.436***(1.11, 1.86)	1.503***(1.14, 1.98)
Wealth Quintile					
Poorest®					
Poorer	1.224***(1.13, 1.33)	0.598(0.27, 1.32)	0.634*(0.38, 1.07)	1.194(0.76, 1.86)	1.312(0.86, 1.99)
Middle	1.401***(1.29, 1.52)	1.003(0.5, 2.01)	1.038(0.64, 1.67)	1.134(0.72, 1.8)	0.971(0.65, 1.46)
Richer	1.844***(1.7, 2)	0.817(0.41, 1.62)	1.121(0.7, 1.81)	1.169(0.75, 1.83)	1.664***(1.13, 2.45)

Richest	2.267***(2.09, 2.46)	1.006(0.5, 2.01)	1.432(0.89, 2.31)	1.918***(1.24, 2.96)	1.767***(1.2, 2.6)
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Note: AOR: Adjusted Odds Ratio; ®Reference category; Level of Significant

*** $P < 0.001$, ** $P < 0.01$, * $P < 0.05$

Discussion

The present study investigates the dual burden of malnutrition among adults aged 45 years and above in high-burden states in India, using nationally representative LASI Wave 1 data (2017-18). Through the findings, it is evident that underweight and overweight/obesity coexist in older adults, with evidence of the complicated nutritional transition in India. Approximately one-fifth of older adults were underweight (21%). At the same time, a considerable proportion of older adults were experiencing the opposite nutritional burden, with 28 percent classified as overweight or obese. The spatial differences are significant across India's states. Odisha, Jharkhand, Chhattisgarh, and Uttar Pradesh are examples of states with a higher prevalence of underweight among older adults. Conversely, overweight and obesity occur at a significantly higher rate in more urbanized and economically developed states like Kerala, Punjab, Karnataka, and Chandigarh. This geographic variation indicates inconsistent levels of nutrition transition across India and supports the need for region-specific policy responses rather than the application of a national strategy.

The study also shows that there is a high socioeconomic patterning of undernutrition in old age. Underweight was much more prevalent in males, the oldest age groups, persons with no formal education, Scheduled Tribes, rural residents, and in the poorer wealth quintiles. The multivariate analysis also shows that the risk of underweight increases with advancing age, whereas higher education, urban residence, and better economic conditions are protective. These results indicate that cumulative life-course deprivation and structural disadvantage are strongly correlated with undernutrition in old age. Similar socioeconomic gradients in underweight among elderly individuals have been observed in Indian studies ([Chakraborty et al., 2022](#); [Chowdhury et al., 2018](#)).

On the contrary, overweight and obesity were clustered among females, urban dwellers, well-educated people, and more affluent families. The regression outcome reveals that females were much more likely to be overweight/obese than males, and the chances were much greater with education, urban living, and prosperity. These trends are highly indicative of the nutrition transition model, in which economic progress, urbanization, reduced physical activity, and dietary shifts toward energy-dense foods have led to increased excess weight ([Subramanian & Smith, 2006](#); [Subramanian et al., 2011](#)). The increased risk in women is also consistent with prior data from India, which indicate gender differences in physical activity and metabolic risk ([Devi et al., 2020](#); [Muhammad et al., 2022](#)).

Malnutrition among the ageing population is further highlighted by age gradients. The likelihood of underweight was on an upward trend with age, culminating in the highest likelihood at the age group of 80 years and above, and the likelihood of overweight/obesity decreased with the increase of age. It might indicate age-related physiological changes, a heavier burden of morbidity, and the potential selection of the elderly who survive ([Evans,](#)

2005; Norman et al., 2021). These age-specific trends in BMI are also observed in other developing countries (Jiesisibieke et al., 2023).

The study indicates that older adults are multidimensionally and socially stratified to be malnourished in India. The co-occurrence of undernutrition among disadvantaged groups and overnutrition among better-off populations is a classic example of a dual burden. The solution to this new issue will involve combined policy approaches to prevent deprivation-induced undernutrition risks and obesity-induced risks in the ageing population.

Strengths and Limitations of the Study

This study has several strengths. First, it uses data from LASI, which is nationally representative and provides strong estimates for adults aged 45 years and above. A large sample size increases statistical power and is more likely to yield generalizable results. Second, using objectively measured height and weight minimizes bias in reporting and enhances the accuracy of BMI classification. Third, the study provides comprehensive state-level evidence, especially in high-burden states, which could help gain insights into regional heterogeneity in the dual burden of malnutrition. Lastly, it is found that multivariate logistic regression was used to adjust for various socioeconomic and demographic variables, thereby enhancing the validity of the identified associations.

Nevertheless, there are some limitations to note. To begin with, the cross-sectional nature of LASI Wave 1 does not allow causal explanation of the relations found. Second, BMI might not adequately reflect age-induced alterations in body composition, including sarcopenia and fat redistribution, as are specifically pertinent in the elderly. Third, the analysis lacks descriptions of dietary intake, the intensity of physical activity, and clinical comorbidities, which can introduce residual confounding. Fourth, the oldest-old may be underestimated for malnutrition because weaker individuals may not live to very old age. The study provides valuable, nationally representative data on the dual burden of malnutrition among India's ageing population, despite these limitations.

Conclusion

This study provides a clear demonstration of a twofold burden of malnutrition among adults aged 45 years and above in India. Underweight is still disproportionately focused on socioeconomically disadvantaged, rural, and older people, whereas overweight and obesity have become widespread among women, urban dwellers, and more fortunate population groups. Such patterns are complementary to the current nutritional and epidemiological transitions across India's ageing population. To tackle this dual burden, two-fold policy solutions are needed, which would help in fighting the endemic underfeeding and increasing obesity rates among the elderly population. Enhancing routine nutrition screening in primary healthcare, focusing on high-burden states, promoting healthy ageing behaviours, and reducing socioeconomic disparities will be instrumental in improving nutritional performance. Given India's vast ageing population, incorporating geriatric nutrition into primary healthcare and social protection programmes is a major policy consideration. Longitudinal evidence that could

better explain the life-course pathways and behavioural determinants that define nutritional status in old age should be applied in future research.

Declarations:

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Conflicts of interest/Competing interests: Not Applicable

Ethics Declaration: Not Applicable. There is no formal ethics approval required for this particular study since the study is based on secondary data and the survey data is available in the public domain and can be extracted from: <https://www.iipsindia.ac.in/content/LASI-data>

Consent to participate: Not Applicable

Availability of data and material: The data of a particular study is available in the public domain and can be extracted from: <https://www.iipsindia.ac.in/content/LASI-data>

Ethics Declaration: Not Applicable. There is no formal ethics approval required for this particular study since the study is based on secondary data and the survey data is available in the public domain and can be extracted from: <https://www.iipsindia.ac.in/content/LASI-data>

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