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Gender differentials in prevalence and distribution of BMI categories among older adults in various strata of society in India

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***Abstract*---**The study aims to estimate the prevalence of underweight, overweight and identified the gender differentials among various strata of 50 years and above older populations in India. A national representative cross-sectional data of n=7273 older adults from WHO's Study on global AGEing and adult health (SAGE wave1) India, was used. Underweight was defined as body mass index (BMI) <18.5 Kg/M2 and >25 Kg/M2 as overweight. A wealth index was created by cumulating the inverse proportion rate of assets acquired by individuals. The various stratifying axes comprised age, caste, and wealth. Bi-variable cross-tabulation with Chi-squared tests was used to test the differences in the distribution of nutritional status across various strata. 35.5% were underweight, 49.7% were normal weight and 14.7% were overweight. Most women were overweight (10.9% men~18.6% women, p<0.001), and fewer women were underweight (36.5% men~34.5% women, p<0.001) reflecting a gendered difference in nutritional status. Further, there was a dose-response relationship in nutritional status. The distribution across the caste groups was significantly graded, privileged being more overweight and less privileged being underweight. A similar pattern of hierarchical difference was seen for the wealth index. The result provides insight into the complex issue of nutritional inequality among older Indian adults with a strong inverse relationship between underweight and social privilege, wealth, and a direct upward gradient pattern for overweight.

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Introduction

Nutritional status among older adults has become a rising public-health issue in developing countries with a rapid rise in ageing populations(Selvamani & Singh, 2018). Ageing process is impacted by diet, lifestyle, and hereditary as well as social factors. Furthermore, the natural physiological and metabolic changes that occur as people age might have an impact on their nutritional status(Ahmed & Haboubi, 2010; Amarya et al., 2015). Malnutrition is a consistent health problem among the older adult in India and it can take various forms causing numerous issues(Ahmed & Haboubi, 2010; Landi et al., 2016). Malnutrition is caused by a variety of factors including poor diet, food insecurity, poor health, education, social and gender relations, economic, and political conditions(Gupta et al., 2018).

According to the World Health Organization (WHO) classification, underweight can be defined as a body mass index (BMI) of <18.5 kg/m2 for adults(Pasco et al., 2014). According to the 2018 Global Nutrition Report, the prevalence of underweight among women decreased gradually from 11.6 percent in 2000 to 9.7 percent in 2016, whereas adult obesity increased dramatically by 0.32 kg/m^2 each decade(NCD Risk Factor Collaboration (NCD-RisC), 2017). Several studies have documented the persistence of this double-edged sword of malnutrition at various strata of society(Young et al., 2020). The overwhelming effect of which diminishes human productivity and both being underweight and being overweight are linked to a higher risk of poor health and mortality(Nguyen et al., 2021). Earlier research in India suggests that identifying factors related to malnutrition in the older population is crucial for preventing morbidity and mortality in this population(Ng, 2020). Different groups of the population are frequently affected by being underweight and overweight. This is particularly relevant for women, who have been proven to be influenced by factors such as age, socioeconomic position (SES), caste, domicile location, wealth status, and so on(Ng, 2020). In India, the gendered context of daily life affects men and women differently and makes them vulnerable in a variety of ways. Men and women's access to and control over resources are also influenced by their gender (Srivastava et al., 2021). So a natural inquiry is whether such features and nutritional extremes have a consistent pattern or not. Understanding gender differences in the BMI category among older individuals in India is critical. In addition, the paper examines both genders' intersectionality by taking into account contextual elements such as caste, wealth index, etc. Mostly BMI categories prevalence and its social patterning have been examined sparsely in India, with most studies focusing on children, adolescents, and young adults and mostly restricted to certain regions or smaller samples. Not much is known about older adults' nutritional status. The study hypothesized the fact that socio-economic strata had no effect on BMI category among older adults. Moreover, the study also hypothesizes that there were no gender differentials in the prevalence of underweight and overweight among older adults in India.

Therefore, we aimed to estimate the prevalence and social pattern of underweight and overweight—among Indians aged 50 years and more—in a nationally-representative sample. To put the problem into perspective, we aimed to investigate gender-specific BMI categories across different societal strata

Methods

For the present analyses, data from the World Health Organization's Study on Global AGEing and Adult Health (WHO-SAGE-Wave 1- 2010) was used. It is a multi-country cross-sectional population-based survey conducted in the six country study (India, Ghana, Russian Federation, South Africa, and Mexico). In India, the survey was carried on national representative older adults aged 50 and above. The research was carried out in six states: Assam, Uttar Pradesh, West Bengal, and Bihar,Karnataka, Maharashtra, a nd Rajasthan. The study's sample size was 7273 based on a multi-staged clustered sample and probability proportional to size sampling design.

Outcome Variable

Body mass index (BMI) was calculated as measured weight (kg)/measured height $(m)^2$ and then coded into a categorical variable. Here underweight was defined by body mass index (BMI) < 18.5 $(kg)/(m)^2$, Normal(18.5-24.9) $(kg)/(m)^2$, and Overweight(>25) $(kg)/(m)^2$.
The wealth index was calculated using household assets as a proxy for wealth, original data on 18 assets (cars, electricity, bicycle, kitchen sink, washing machine, dishwasher, refrigerator, employed someone, mobile, bullock cart, computer, music centre, Livestock, Internet, motorbike, second home, Land, valuable items,) were used to create wealth index and then it is transformed to quintiles.

Independent Variable

The age group was categorized as 50+, 60+, and 70 and above. Gender was coded as men and women. The residence was taken as rural and urban. From a life-course perspective, gender differences in older persons' socioeconomic situations are clearly evident. Social determinants like Caste, Religion, and education were taken as the independent variable.

Statistical analysis

Descriptive statistics with percentages were used in this investigation. A wealth index was created by cumulating the inverse proportion rate of assets acquired by individuals in the study population. The resulting wealth index is cut into five wealth quintiles to understand the gendered influence of wealth on BMI categories. The distributions of three-level BMI (underweight, normal weight, and overweight) across the socioeconomic factors were assessed using the chi-square test. For the analyses, R software (R.4.1.2) was used.

Results

In the study population, the average age of older adults was 61.8 ± 9.4 years. Among them (n=3234)44.4% were within 50 to 60 years, (n=2491) 34.2% were 60 to 70 years and (n=1548) 21.2% Indians were aged 70 years and above. Overall 26.1% of older adults resided in urban whereas 73.9% resided in urban India. The percentage distribution of background characteristics for older adults aged 50 and up is shown in Table 1.

Table 1 Distribution of background characteristics in Indians aged 50 years and older in SAGE sample (n=7273) (2007–2010)

Variables	N=7273 (Percentage)
Age (years)	
50–59	3234(44.4)
60–69	2491(34.2)
70+	1548(21.2)
Gender	
Men	3682(50.6)
Women	3591(49.4)
Caste	
No caste or tribe	1132(17.1)
Other	3979(60.1)
Scheduled caste	1102(16.6)
Scheduled tribe	400(6)
Religion	
Buddhism	78(1.2)
Christianity	43(0.6)
Hinduism	5603(84.3)
Islam	803(12.1)
Jainism	56(0.8)
Sikhism	38(0.6)
Other	10(0.2)
Education	
Less than primary	754(23.3)
Completed primary	941(29.1)
Completed secondary	662(20.5)
Completed HS	551(17)
Completed college/university	227(7)
Completed post-grad	101(3.1)
Residence	
Rural	5374(73.9)
Urban	1899(26.1)

Table 2 illustrates the percentage of older men and women in India by their background factors. Among the study participant (women -46.8% vs. men-42.2%) were within 50 to 60 years, (women -33.2% vs. men-35.3%) were 60 to 70 years and (women -20% vs. men-22.5%) were aged 70 years and above. Around (women -72.4% vs. men-75.3%) older adult resided in urban whereas (women -27.6% vs. men-24.7%) resided in urban India.

Table 2 Gendered difference in distribution of various background variables for older people (50 and above) in India, 2007–2010 (N = 7273)

Variables	Women N(Percentage)	Men N(Percentage)
Age (years)		
50–59	1681(46.8)	1553(42.2)
60–69	1192(33.2)	1299(35.3)
70+	718(20.0)	830(22.5)
Caste		
No caste or tribe	597(16.6)	535(14.5)
Other	1958(54.5)	2021(54.9)
Scheduled caste	536(14.9)	566(15.4)
Scheduled tribe	185(5.2)	215(5.8)
Religion		
Buddhism	41(1.1)	37(1.0)
Christianity	22(0.6)	21(0.6)
Hinduism	2786(77.6)	2817(76.5)
Islam	384(10.7)	419(11.4)
Jainism	31(0.9)	25(0.7)
Sikhism	20(0.6)	18(0.5)
Other	6(0.2)	4(0.1)
Residence		
Rural	2600(72.4)	2774(75.3)
Urban	991(27.6)	908(24.7)

The Body mass index (BMI) was calculated as measured weight (kg)/measured height $(m)^2$ and was categorized to underweight, normal, and overweight (>25). The study shows the prevalence of underweight was 35.4% and overweight was 14.7 %. (Table 3)

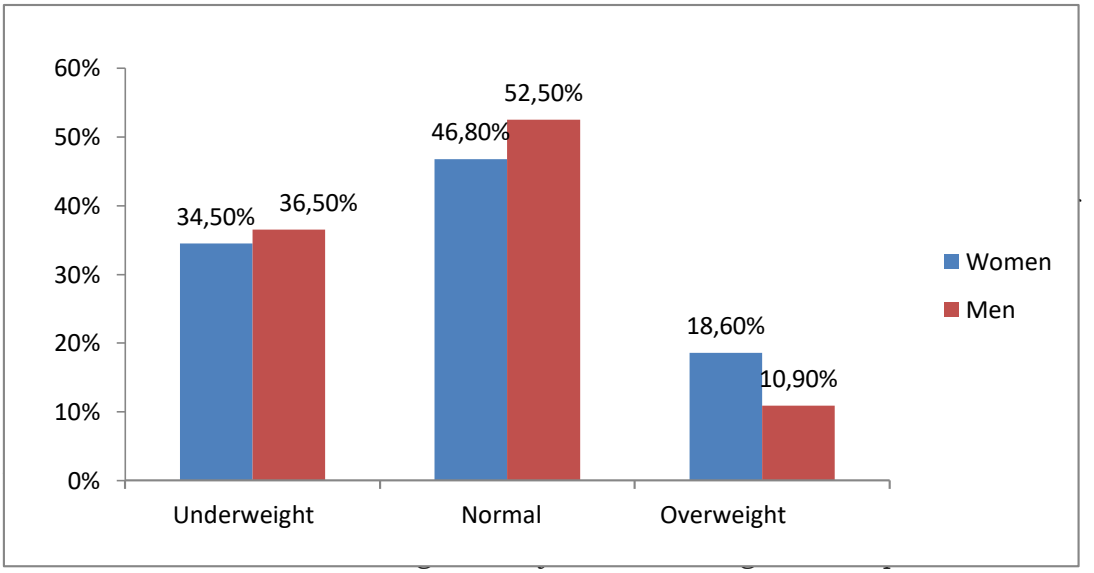
Table 3 Distribution of BMI categories among older adults in Indians in SAGE sample (n=7273) (2007–2010)

BMI kg/m2	N (Percentage)
Underweight (<18.5)	2315(35.6)
Normal (18.5-24.9)	3224(49.6)
Overweight (>25)	955(14.7)

Figure1 shows the percentage of underweight, normal weight, and overweight among older men and women aged 50 years and above in India. The prevalence of underweight was 36.5% for men as compared to 34.5% among women. Whereas men were less overweight in contrast to women (men 10.9% vs. women 18.6%)
Moreover, there was a dose-response relationship in a caste where n=194(49.1%) Scheduled tribes were underweight, and with the increase in privilege the underweight reduced i.e. – general caste n=337(30.4%) ($p<0.0001$). It was reflected in those having less than primary education of whom n=260(35.4%) were found to be more underweight compared to those having higher education. Underweight accelerated over, as wealth index declined n=730(54.4%), relative to those who possess more assets with higher wealth index n=227(18.3%)

(p<0.0001). A similar pattern of dose-response relationship was observed between overweight and caste (scheduled tribes n= 31 (3.2%) vs. general caste n= 654 (68.5.4%)) (p<0.0001), wherewith the increase in privilege the overweight increased. Overweight precipitated in higher wealth index (declined wealth index n= 73 (7.8%) vs. higher wealth index n= 362 (38.6%); (p<0.0001)) was marked. Furthermore, we found a hierarchical difference in nutritional status across different strata. But other strata like religion didn't reflect variation in nutritional status.

Figure 1: Gendered difference in distribution of BMI for older people (50 and above) in India, 2010 (N = 7273)



The corresponding prevalence of overweight was more for women across all strata in contrast to men (p<0.0001). A consistent distinct trend was evident across privileged strata of the society. Overweight was significantly more prevalent among women as compared to men having higher wealth and caste (Men (other caste (12.4%), Higher wealth index (21.4%)) vs. women (other caste (21.6%), Higher wealth index (37.3%)) (p<0.0001). The corresponding prevalence of underweight was significantly more prevalent among men as compared to women having lower wealth assets and less privileged caste (Men (Scheduled caste (47.2%), bottom wealth index (56.0%)) vs. women (Scheduled caste (44.1%), bottom wealth index (51.4%))(p<0.0001). (Table-4)

Table 4 Bivariate analysis showing the percentage distribution of BMI categories among various socio-economic strata for older people (50 and above) in India, 2007–2010 (N = 7273)

Variables	Women Number(Percentage)			P Value	Men Number(Percentage)			P Value
	Under weight	Normal	Over weight		Under weight	Normal	Over weight	
Age (years)				<0.0001				<0.0001
50–59	466(30.2)	734(47.6)	341(22.1)		415(29.9)	785(56.5)	189(13.6)	
60–69	377(35.5)	512(48.2)	173(16..3)		432(37.8)	610(53.3)	102(8.9)	
70+	264(43.9)	255(42.4)	83(13.8)		351(47.1)	328 (44.0)	67(9.0)	
Caste				<0.0001				<0.0001
No caste or tribe	166(28.6)	293(50.5)	121(20.9)		170(32.2)	288 (54.5)	70(13.3)	
Other caste	603(31.7)	888(46.7)	410(21.6)		665(33.8)	1060(53.8)	244(12.4)	
Scheduled caste	231(44.1)	247(47.1)	46(8.8)		262 (47.2)	263(47.4)	30(5.4)	
Scheduled tribe	95(52.2)	68(37.4)	19(10.4)		98 (46.2)	102(48.1)	12(5.7)	
Residence				<0.0001				<0.0001
Rural	930 (39.9)	1070(45.9)	330(14.2)		1032(41.3)	1273(51.0)	193(7.7)	
Urban	177(20.2)	431(49.3)	267(30.5)		166(21.3)	450(57.6)	165(21.1)	
Wealth Index				<0.0001				<0.0001
1	336(51.4)	268 (41.0)	50(7.6)		362(56.0)	261(40.4)	23(3.6)	
2	275(41.9)	298 (45.4)	83(12.7)		281(44.2)	330(51.9)	25(3.9)	
3	204(33.3)	302(49.3)	107(17.5)		237(35.5)	359(53.8)	71(10.6)	
4	168(27.3)	330(53.6)	118(19.2)		177(26.9)	382(58.0)	100(15.2)	
5	108(17.5)	279 (45.2)	230(37.3)		120 (19.4)	366(59.2)	132(21.4)	

Discussions

According to the findings of this study, the prevalence of underweight (35.5%) normal weight (49.7%), and overweight was (14.7%) among older adults. A study by Selvamani shows the prevalence of underweight was 38 percent (Selvamani & Singh, 2018). Another study from the Longitudinal Ageing Survey's first wave in India (2017–18) shows the overall prevalence of underweight and overweight among elderly above 45 years was 20.64, and 20.65 respectively(Bramhankar et al., 2021).

The gendered difference in nutritional status was seen where more women in overweight (10.9% in men versus 18.6% in women, p<0.001) and fewer women in underweight (36.5% in men versus 34.5% in women, p<0.001) making underweight seemed favorable for men in contrast to women. A study by Rai et al. shows among >18 years of Indian adults 17.3% of men and 24.7% of women were overweight in 2017 and 35.6% of men and 33.3% of women were underweight(Rai et al., 2018). Similarly to our pattern of women with more proportion overweight than males, a study by Kim et al. also shows, that 42.2% of females were obese compared to 31.7% of males(Kim et al., 2011). Our study finds a dose-response relationship in a nutritional status similar to another study by Shalini et al. shows the prevalence of frailty was higher in the lowest tertile compared to the

highest tertile (Shalini et al., 2020). In contrast to our finding a study by Templin et al shows that obesity among the wealthiest decile(3.5%) was stable and increased in obesity proportion among the poorer section(14.3%) (Conklin et al., 2013; Templin et al., 2019) According to our result 49% in the least-privileged section are being underweight as compared to 30% in privileged caste. Another review shows that risk factors like less privileged section, financial difficulties, and gender affect the underweight status of older adults(Nazri et al., 2021). It was observed in our study that the distribution across the caste groups was significantly graded, the privileged being more overweight (7.9% in least-privileged ~ 17.2% in privileged caste, $p<0.001$). A study by Lartey et al shows that higher household wealth, and being privileged were associated with higher odds of being overweight(Lartey et al., 2019). We found a pattern of hierarchical difference as underweight accelerated over, as wealth index declined and relative to those who possess more assets with higher wealth index. Overweight increased with a higher wealth index as compared to a lower wealth index. Studies show malnutrition (overweight and underweight) can be seen regardless of socioeconomic status(Hoogendijk et al., 2018; Kaplan et al., 2003; Yeom et al., 2009).

Conclusions

The result shows new insight into the complex inequality among the privileged and privileged groups. It depicts variation in BMI categories across different strata of society in India. Underweight affects older adults belonging to lower wealth index and less privileged section and overweight affects older adults belonging to higher wealth index and privileged section. Interventions focusing on behavior change among the older adults of lower socioeconomic strata for underweight and higher socioeconomic strata for overweight are required to address the nutritional issue in the growing older population in India. The study highlights that being underweight seemed favorable for men in contrast to women being more inclined to be overweight. To enhance the general well-being of older adults, gender-specific public policy is required to address such nutritional issues.

Limitations

The study used cross-sectional data therefore it may have potentially affected the causal inferences. Future longitudinal research, particularly in developing countries, should be done to better investigate the risk of determining gender differences in nutritional status.

Conflict of interest

The authors declare that there are no conflicts of interest.

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