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ORIGINAL RESEARCH

Prevalence and correlates of underweight and overweight/obesity among women in India: results from the National Family Health Survey 2015–2016

Supa Pengpid[1,2]
Karl Peltzer[2]

[1]ASEAN Institute for Health Development, Mahidol University, Salaya, Nakhonpathom, Thailand; [2]Deputy Vice Chancellor Research and Innovation Office, North West University, Potchefstroom, South Africa

Objective: The study aimed to assess the prevalence and correlates of underweight and overweight or obesity among women in India.

Subjects and methods: In a population-based cross-sectional 2015–2016 National Family Health Survey, ever married non-pregnant women (18–49 years) were interviewed and assessed with anthropometric, blood pressure and biochemical measures.

Results: The total sample included 5,82,320 non-pregnant women 18–49 years, median age 31 years, interquartile range =16 years, from India. Overall, 20.1% of the women were underweight [body mass index (BMI) <18.5 kg/m^2] and 36.3% were overweight, or had class I or class II obesity (BMI ≥23.0 kg/m^2). In adjusted multinomial logistic regression, younger age, lower education, lower wealth status, not eating daily fruits, vegetables, fried food, belonging to the scheduled tribe and tobacco use were associated with underweight, while older age, higher education, higher wealth, belonging to other backward class or other, urban residence, daily fruit consumption, daily fried food consumption, having hypertension, heart disease and high or very high blood glucose levels were associated with overweight or obesity. Belonging to the scheduled caste and tobacco use were negatively associated with overweight or obesity.

Conclusions: A high dual burden of both underweight and overweight or obesity was observed among women in India. Sociodemographic and health variables were identified as risk factors for both underweight and overweight or obesity, which can be utilized in informing intervention strategies.

Keywords: women, underweight, overweight, obesity, health variables, India

Introduction

Over the past 40 years, the global prevalence of underweight (18.5<kg/m^2) decreased to 9.7% in women, and the prevalence of obesity [body mass index (BMI) ≥30 kg/m^2] went up to 14.9% in women.[1] In the Indian National Family Health Survey, among women aged 15–49 years in 1998 and 2005, the prevalence of underweight was 35.9% and 32.8%, respectively, and the prevalence of overweight or obesity (BMI ≥23 kg/m^2) was 18.8% and 23.4%, respectively.[2] Among women (18–60 years) in 10 states in India, the prevalence of underweight decreased "from 52% during 1975–1979 to 34% during 2011–2012" and the prevalence of overweight or obesity (BMI ≥23 kg/m^2) increased from 7% to 24% during the same period.[3] In a study among adults (20–80 years) in rural South India in 2013–2014, the prevalence of underweight was 22.7% and the prevalence of overweight or obesity (BMI ≥23 kg/m^2) 34.3%.[4] There is lack of more recent national data on the bodyweight status and its correlates among women in India.

Correspondence: Karl Peltzer
Deputy Vice Chancellor Research and Innovation Office, North-West University, Potchefstroom Campus, 11 Hoffman Street, Potchefstroom 2531, South Africa
Email kfpeltzer@gmail.com

Underweight in adulthood can have significant adverse health effects[5] and obesity has been found to be associated with non-communicable illnesses, such as cardiovascular disease, hypertension, and diabetes mellitus.[6] As previously reviewed,[7] risk factors for adult underweight may include sociodemographic factors, including younger and older adults, lower education, economic status, and residing in rural areas. In addition, health-related risk factors for underweight may include smoking, diets with inadequate nutrient density and fear of being obese, while having chronic conditions may decrease the odds for underweight.[7]

Risk factors for overweight or obesity, include, as reviewed in Pengpid et al[7] middle-aged, higher education and higher economic status, urban residence, dietary risk behaviors, such as eating foods high in sugars and fat, insufficient fruit and vegetables consumption and physical inactivity. In addition, smoking may decrease the odds for obesity, and having chronic illnesses and conditions, such as type 2 diabetes and hypertension, may increase the odds for obesity.[7] A better understanding of risk factors for both under- and over nutrition may help in providing better-designed health interventions. The aim of this investigation was to assess the prevalence and correlates of underweight and overweight or obesity in the most recent (2015–2016) nationally representative survey among women in India.

Methods
Study design and participants

Participants were women (18–49 years) that took part in the cross-sectional 2015–2016 India National Family Health Survey (NFHS-4).[8] They were selected in a two-stage stratified sampling design, and the individual response rate was 94.5%.[8] The analysis design in this paper is restricted to a national sub-sample of women that were not pregnant and had completed anthropometric measurements (N=5,82,320) of the NFHS-4. Prior to the investigation, informed consent was attained from the study respondents. The ethics committees of the institutions that implemented the NFHS-4 approved the study protocol.[8] "Permission to use the NFHS-4 data in this analysis was obtained from the Demographic and Health Surveys (DHS) Programme."

Measures

Anthropometry: "Height and weight of adult women were measured using the Seca 874 digital scale."[8] "BMI was calculated according to Asian criteria: underweight (<18.5 kg/m^2), normal weight (18.5 to <23.0 kg/m^2), overweight (23.0 to <25.0 kg/m^2) and obese (≥25 kg/m^2)."[9]

Blood pressure measurement: "Blood pressure was measured using an Omron Blood PressureMonitor. Blood pressure measurements for each respondent were taken three times with an interval of 5 mins between readings."[8] "Respondents whose average systolic blood pressure was >140 mm Hg or average diastolic blood pressure was >90 mm Hg and/or were taking anti-hypertensive medication were considered to have hypertension."[8]

Blood glucose testing: "Random blood glucose (RBS) was measured using a finger-stick blood specimen for using the FreeStyle Optium H glucometer with glucose test strips."[8]

Other health issues assessed by structured interview included tobacco and alcohol use, current morbidity (heart disease), fruit, vegetable, fried food and aerated drinks consumption.[8]

Sociodemographic variables assessed included age, formal education, economic or wealth status, residential status, religion, and caste.[8]

Data analysis

Data were analyzed using "STATA software version 15.0 (Stata Corporation, College Station, TX, USA)" by considering the multi-stage sampling design of the survey. Descriptive statistics were utilized to present the prevalence of body weight status and the sample characteristics. Chi-square tests were used to calculate differences in proportions. Multinomial logistic regression was performed to estimate associations between independent variables (sociodemographic and health-related factors) and dependent variables of underweight and overweight/obesity; normal body weight status was the reference category. P<0.05 was regarded as statistically significant.

Results
Sample characteristics and prevalence of body mass index status

The total sample included 5,82,320 women 18–49 years (median age 31.0 years, inter quartile range =16.0) from India. Overall, 20.1% of the women was underweight (BMI <18.5 kg/m^2), 43.6% had normal weight (BMI 18.5–22.9 kg/m^2), 13.6% overweight (23.0–24.9 kg/m^2), 17.0% class I obesity (BMI 25.0–29.9 kg/m^2), and 5.7% class II obesity (BMI ≥30.0 kg/m^2) (or 36.3% overweight, class I or class II obesity). Tables 1 and 2 summarize the sociodemographic and health characteristics of the sample and

Table 1 Sample and nutritional status by sociodemographic and health variables among women, 2015–2016 India National Family Health Survey

Variable	Sample	Under-weight	Normal weight	Over-weight	Class I Obesity	Class II Obesity	Statistic
		BMI: <18.5 kg/m²	BMI: 18.5–22.9 kg/m²	BMI: 23.0–24.9 kg/m²	BMI: 25.0–29.9 kg/m²	BMI: ≥30.0 kg/m²	*P*-value
	N (%)	%	%	%	%	%	
All	5,82,320	20.1	43.6	13.6	17.0	5.7	
Age in years							
18–24	1,52,934 (26.0)	31.1	51.4	8.7	7.0	1.7	<0.001
25–29	1,03,410 (17.7)	21.2	47.0	13.5	14.6	3.8	
30–39	1,79,545 (30.8)	15.7	41.0	15.7	20.6	7.0	
40–49	1,46,429 (25.5)	13.7	36.2	16.3	24.4	9.3	
Education							
None	1,81,400 (30.4)	23.8	48.2	12.4	12.3	3.3	<0.001
Primary	77,838 (13.3)	20.3	46.2	13.5	15.4	4.6	
Secondary	2,39,772 (42.5)	18.1	45.0	14.1	17.3	5.5	
Higher	73,310 (13.9)	15.3	45.1	15.3	18.4	5.9	
Wealth status			53.1				
Poorest	1,07,372 (17.1)	32.6	51.5	8.2	5.2	0.8	<0.001
Poorer	1,22,243 (19.3)	25.0	47.6	11.9	9.9	1.8	
Middle	1,22,722 (20.6)	18.8	41.7	14.5	15.5	3.7	
Richer	1,17,458 (21.5)	13.9	36.9	16.0	21.5	6.8	
Richest	1,12,525 (21.5)	9.3		17.3	25.8	10.8	
Caste							
Scheduled caste	1,02,878 (18.5)	22.4	45.4	13.2	14.8	4.2	<0.001
Scheduled tribe	1,05,837 (19.1)	30.1	49.0	10.0	8.8	2.1	
Other backward class	2,26,770 (40.9)	19.9	43.6	13.7	17.2	5.7	
Other	1,19,289 (21.5)	15.2	39.9	15.3	21.4	8.1	
Residence							
Rural	4,10,051 (65.1)	22.6	48.9	12.7	12.7	3.1	<0.001
Urban	1,72,269 (34.9)	13.1	39.7	16.0	22.6	8.7	
Health behaviour							
Fruit consumption (daily)	61,860 (12.2)	12.0	37.3	16.6	24.1	10.0	<0.001
Dark green leafy vegetables (daily)	2,88,458 (47.5)	19.2	43.4	14.0	17.5	5.9	<0.001
Fried food (daily)	68,813 (9.9)	19.1	43.4	14.6	17.6	5.3	<0.001
Aerated drinks (daily)	27,856 (4.5)	17.5	43.4	14.4	18.1	6.5	<0.001
Tobacco use	57,572 (6.4)	27.4	44.9	12.1	12.4	3.3	<0.001
Drinks alcohol	15,861 (1.4)	18.3	51.1	15.4	12.6	2.5	<0.001
Physical conditions							
Hypertension	77,953 (13.5)	11.2	34.5	16.1	26.7	11.5	<0.001
Heart disease	9,660 (1.5)	16.0	38.2	14.8	21.7	9.4	<0.001
Random blood glucose							
High (141–160 mg/dL)	19,327 (3.3)	14.9	37.6	14.7	23.2	9.7	<0.001
Very high (>160 mg/dL)	16,304 (3.1)	9.9	27.6	14.2	31.0	17.4	

by BMI status. In bivariate analyses, BMI status was higher in the older aged, better educated, higher wealth status, urban residence, those who engaged in alcohol use, higher fruit consumption, had heart disease, hypertension, and high glucose levels. The body weight status was lower in current tobacco users (see Table 1).

Table 2 Associations of independent variables with underweight and overweight or obesity (with normal weight as reference category) among women

Variable	Underweight (<18.5 kg/m^2)	Overweight/obesity (≥23 kg/m^2)
	ARRR (95% CI)	ARRR (95% CI)[b]
Sociodemographics		
Age in years		
18–24	1 (Reference)	1 (Reference)
25–29	0.71 (0.69, 0.73)***	2.10 (2.03, 2.18)***
30–39	0.56 (0.54, 0.58)***	3.44 (3.33, 3.55)***
40–49	0.54 (0.52, 0.56)***	4.39 (4.24, 4.54)***
Education		
None	1 (Reference)	1 (Reference)
Primary	0.91 (0.88, 0.94)***	1.24 (1.20, 1.28)***
Secondary or more	0.86 (0.84, 0.88)***	1.36 (1.32, 1.40)***
Wealth index		
Poorest	1 (Reference)	1 (Reference)
Poorer	0.87 (0.85, 0.90)***	1.63 (1.57, 1.69)***
Middle	0.74 (0.71, 0.76)***	2.36 (2.28, 2.45)***
Richer or richest	0.57 (0.55, 0.59)***	3.46 (3.33, 3.59)***
Caste		
Scheduled caste	1 (Reference)	1 (Reference)
Scheduled tribe	1.12 (1.07, 1.18)***	0.75 (0.72, 0.79)***
Other backward class or Other	0.98 (0.94, 1.01)	1.03 (1.00, 1.06)*
Urban residence (base = rural residence)	0.89 (0.85, 0.92)***	1.34 (1.30, 1.38)***
Health variables		
Fruits (daily) (base = less than daily)	0.88 (0.84, 0.92)***	1.20 (1.16, 1.24)***
Dark vegetables (daily) (base = less than daily)	0.96 (0.94, 0.98)***	0.99 (0.97, 1.01)
Fried food (daily) (base = less than daily)	0.95 (0.91, 0.99)*	1.08 (1.04, 1.13)***
Aerated drinks (daily) (base = less than daily)	0.94 (0.89, 0.99)*	0.96 (0.90, 1.00)
Tobacco use	1.33 (1.28, 1.38)***	0.79 (0.76, 0.83)***
Drinks alcohol	0.94 (0.87, 1.01)	0.95 (0.87, 1.03)
Hypertensive (base = no)	0.80 (0.77, 0.83)***	1.98 (1.92, 2.03)***
Heart disease (base = no)	0.96 (0.88, 1.05)	1.16 (1.08, 1.25)***
Random blood glucose		
High (141–160 mg/dL)	0.95 (0.89, 1.01)	1.49 (1.41, 1.57)***
Very high (>160 mg/dL)	0.87 (0.80, 0.95)**	2.11 (1.99, 2.25)***

Notes: ***$P<0.001$; **$P<0.01$; *$P<0.05$.
Abbreviation: ARRR, adjusted relative risk ratio.

Associations with the prevalence of underweight and overweight/obesity

Factors independently and positively associated with underweight were belonging to the scheduled tribe and tobacco use, while older age, higher education, higher wealth, daily fruit consumption, daily dark vegetable consumption, daily eating of fried food, daily consumption of aerated drinks, having hypertension and very high blood glucose levels were negatively associated with underweight.

Factors independently associated with overweight or obesity were middle and older age, higher education, higher wealth, belonging to other backward class or other, urban residence, daily fruit consumption, daily fried food consumption, having hypertension, heart disease

and high or very high blood glucose levels. Belonging to the scheduled caste and tobacco use were negatively associated with overweight or obesity (see Table 2).

Discussion

In this 2015–2016 NFHS-4 among women (18–49 years), the prevalence of underweight (BMI <18.5 kg/m^2) was 20.1% and overweight or obesity (≥23.0 kg/m^2) was 36.3% (5.7% class II obesity; BMI ≥30.0 kg/m^2). This result shows a further decrease of the prevalence of underweight in women from 32.8% in 2005 to 20.1% in 2015–2016, and a further increase of overweight or obesity from 23.4% in 2005 to 36.3% in 2015–2016.[2] Similar decreases in the prevalence of underweight and increases in overweight or obesity were found in regional studies in India.[3,4] Findings demonstrate a high coexistence of a dual burden of underweight and overweight/obesity in India. The found prevalence of underweight in India is, however, still double as high as the global prevalence among women (9.7%),[1] similar to Vietnam (20.9%),[10] lower than in Bangladesh (in adults ≥35 years) 30.4%,[7] and higher than in women (aged 18–49 years) in Myanmar (14.1%),[11] and in Indonesia (adults ≥18 years) 12.5%.[12] The prevalence of overweight or obesity (≥23.0 kg/m^2) was in this investigation higher than in Bangladesh (≥23 kg/m^2, 23.5%)[13] and in Vietnam (≥23 kg/m^2, 16.3%),[10] lower than in Myanmar (≥23 kg/m^2, 41.1%),[11] Malaysia (≥25 kg/m^2, 51.2%),[14] and with a prevalence of 5.7% obesity (≥30 kg/m^2) lower than the global rate of obesity (≥30 kg/m^2) (14.9% in adult women).[1]

Among the different age groups studied, the highest prevalence of underweight was found among the youngest group (18–24 years) (31.1%), which is in consistence with previous studies.[15] Possible reasons for this may include food insecurity issues[16] and fear of being obese.[17] The latter is supported by an increase of eating disordered attitudes and an underweight body ideal in Southeast Asian countries, including Bangladesh[18] and India.[19] Less than daily fruit, vegetable, fried food and aerated drinks were found to be associated with underweight. This result seems to confirm the association between insufficient food intake and underweight.[16]

In agreement with previous studies,[4,10,12,13,20,21] this study found an association between lower education, lower economic status, residing in rural areas and Schedule tribe groups with underweight. Low socioeconomic status may be related to limited food intake and combined with high manual labor may lead to a net negative energy intake.[4] In consistence with previous studies,[4,13,22] this investigation found that tobacco use increased and having hypertension and very high blood glucose levels reduced the odds of having underweight.

Consistent with previous studies,[4,5,10,13,20,23,24] this study found that older age, higher education, greater wealth, urban residence and other backward class or other groups were associated with having overweight or obesity. Likewise, the chance of overweight/obesity was found to be significantly higher among other backward communities in a previous study in India.[3] The investigation found a higher prevalence of underweight and lower prevalence of overweight/obesity among the scheduled tribe groups. This may be explained by the situation of tribe populations, being largely subjected to discrimination and a socioeconomically disadvantaged group.[23]

Consistent with previous studies,[25,26] this investigation found a correlation between consuming high energy-dense foods (daily consumption of fried food) and overweight or obesity. Contrary to expectation,[27] this study found a positive relationship between daily fruit consumption and overweight or obesity. This finding needs further investigation, in particular on the type of fruits consumed, since each type of fruit may have different effects on body weight.[28] Consistent with a number of previous studies,[11,14,22,29] this study found negative relationship between tobacco use and overweight or obesity. Possible mechanisms through which tobacco use can reduce body weight have been described.[30] Overweight or obesity was in this study significantly and positively associated hypertension, heart disease and high blood glucose levels, which is consistent with previous studies.[23] This result confirms previous results[31,32] that suggest that cardiometabolic comorbities, including hypertension, heart disease and type 2 diabetes, have a relationship with being overweight or obese.

Study limitations

Apart from objective measurements (blood chemistry, anthropometric and blood pressure assessments), questionnaire information was gathered by self-report, which may have biased responses. Since this was a cross-sectional study and causal relationships can be established. The study did not include women 50 years and older, which does not allow us to describe the body weight status of older age groups. Further, some important variables, such as the levels of physical activity, which are relevant in relation to body weight status, were not measured, and should be included in future studies.

Conclusion

The study found a high prevalence of both underweight and overweight or obesity among women (aged 18–49 years) in 2015–16 in India. Compared to previous studies, this study showed a further decline in the prevalence of

underweight and increase of overweight or obesity. Sociodemographic and health variables risk factors were identified for both underweight and overweight or obesity, which can be utilized in informing intervention strategies.

Data availability

The NFHS-4 data are available at https://dhsprogram.com/data/.

Acknowledgments

Disclosure

The authors report no conflicts of interest in this work.

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