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Differences in prevalence and associated factors of underweight and overweight/obesity according to rural–urban residence strata among women of reproductive age in Bangladesh: evidence from a cross-sectional national survey

Mohammad Rashidul Hashan ,[1] Rajat Das Gupta ,[2,3] Brendan Day,[4] Gulam Muhammed Al Kibria [4]

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For numbered affiliations see end of article.

Correspondence to
Dr Mohammad Rashidul Hashan;
hasandmck66@gmail.com

ABSTRACT

Objectives This study aimed to investigate the differences in prevalence and factors influencing underweight and overweight/obesity stratified by region of residence among women of reproductive age in Bangladesh.

Design Secondary analysis of cross-sectional nationwide data.

Setting This study used Bangladesh Demographic and Health Survey 2014 data.

Participants A weighted sample of 16 478 women of reproductive age (15–49 years) were included in the analysis.

Primary and secondary outcome measures Using the Asian-specific cut-off for body mass index, the primary outcome of this study was categorised as: underweight (<18.5 kg/m^2), normal weight (18.5 to <23.0) kg/m^2 and overweight/obese (≥23.0 kg/m^2) stratified according to rural–urban residence.

Results More than half of urban women (53%, n=2493) and one-third of rural women (33%, n=3968) were found to be overweight/obese. Around one-fifth of rural women (21%, n=2490) and almost one in eight urban women (12%, n=571) were reported as underweight. In the final multivariable analyses, increasing age, higher educational status and higher order wealth quintile, each had a significant positive association with being overweight/obese and an inverse association with being underweight. Urban unmarried women had lower odds of being overweight/obese compared with their married counterparts. Rural women who used contraceptives had significantly decreased odds (adjusted OR (AOR) 0.8, 95% CI 0.7 to 0.9) of being underweight compared with contraceptive non-users; no such association was noted in urban women. Women from Sylhet division in both urban (AOR 1.7, 95% CI 1.2 to 2.5) and rural regions (AOR 1.5, 95% CI 1.2 to 1.8) had increased odds of being underweight compared with women in Barisal division.

Conclusions This study found association of multiple factors with both overweight/obesity and underweight among Bangladeshi women of reproductive age. Public health programmes in Bangladesh aiming to prevent the double burden of malnutrition should focus these factors through comprehensive public awareness and cost-effective operational health interventions.

Strengths and limitations of this study

- The study used a nationally representative sample stratifying both urban and rural areas using most recent Bangladesh Demographic and Health Survey (BDHS) 2014 data, making the findings of the present study generalisable for Bangladesh.
- Asian-specific cut-off criterion for body mass index was used to categorise body weight, which is appropriate for this geographical region.
- The study is from secondary analysis of nationwide collected BDHS 2014 survey data, where validated instruments to measure anthropometric data and validated tools by trained field staff for collecting data, thus minimising the probability of measurement error in this study.
- The temporal relationship between the outcome variable and the explanatory variables could not be established due to the cross-sectional nature of the survey.
- Data on several well-known established risk factors (eg, dietary intake, physical activity, sedentary behaviour, visceral adiposity and concomitant diseases) were unavailable in the dataset. In addition, the study included mainly the married women that may not cover the findings of all women within the reproductive age within the country.

INTRODUCTION

According to WHO, in 2016, approximately half of all deaths in low-income and

middle-income countries (LMIC's) were due to nutritional deficiencies, maternal and perinatal conditions, and communicable diseases.[1] Over the past few decades, a major upsurge in overnutrition has occurred among populations persistently plagued by undernutrition, resulting in a 'double burden' of malnutrition in the majority of low/middle-income countries.[2 3] Due to such nutritional transitions, the overall prevalence of overweight/obesity is increasing at a higher rate than underweight.[2 4] In 2014, WHO estimated that around 1.9 billion adults (ie, 18 years or older) were overweight/obese while 462 million were underweight.[5] This double-edged sword of malnutrition (underweight and overweight/obesity) poses serious health risks with implications for both maternal and child health. Being overweight/obese is a leading risk factor for several non-communicable diseases, including cardiovascular diseases, type 2 diabetes mellitus and many other chronic medical illnesses.[6–8] In addition, women with non-normal body weight are particularly prone to various adverse obstetric and neonatal outcomes, such as gestational diabetes, pre-eclampsia, eclampsia, pulmonary embolism, infant mortality, preterm birth, low birth weight and increased risk of early mortality; each of which has been independently associated with overweight/obesity and/or underweight status in women of reproductive age.[9–17] Thereby, such high-risk group populations are more prone to face detrimental health issues compared with men.[18] Regional territories also reported similar vulnerability to these reproductive aged group women indicating the prime need to reflect on this nutritional health problem.[19–21]

Although the prevalence of underweight is declining globally, the rise in obesity is comparatively larger, a trend which affects many LMICs.[22–25] Bangladesh, an LMIC of South Asia with a population of 160 million, is of no exception. Although nationally representative surveys reported remarkable reductions in nutritional deficiencies among Bangladeshi women within past two decades,[26 27] chronic undernutrition prevails as one of the major health concerns. This is evident in a nationwide study, which found 28.0% of rural women and 13.5% of urban women to be underweight.[27] Concurrently, studies identified alarming increases in prevalence of overweight among women of reproductive age (ie, 15–49 years). Since 1996–2011, the prevalence of overweight among urban women increased significantly from 11.4% to 28.9%, whereas overweight prevalence among rural women increased from 1.7% to 12.1%.[26 27] With the gradual rise in overweight/obesity alongside the improving but still substantial prevalence of underweight, the Bangladeshi population and its health system will likely face considerable challenges in addressing the 'double burden' of malnutrition for decades to come.[23 28]

To address these challenges and mitigate problems associated with the 'double burden' of malnutrition, exploration of underlying socioeconomic factors is crucially important. Priority should be given to identifying individual and household risk factors which are influenced by socioeconomic factors including educational level, wealth status and place of residence in order to devise national policy.[29] Substantial differences exist regarding prevalence of many health indicators in addition to differences in socioeconomic status between urban and rural regions in Bangladesh.[27 30] For instance, the prevalence of many non-communicable diseases, such as hypertension, diabetes and overweight/obesity, is substantially higher in urban regions compared with rural regions.[27] So far, several studies have investigated the prevalence of underweight and overweight/obesity among women of reproductive age and reported possible socioeconomic determinants.[4 31–33] However, it is important to further understand these factors when stratifying by rural–urban place of residence among women of reproductive age. Doing so may further bolster our existing health policy in achieving Sustainable Development Goals and targets.[34] Nevertheless, we are aware of no study to date which has performed such a stratified analysis in Bangladeshi women. Therefore, we aimed to address this knowledge gap by evaluating the prevalence of body weight categories (underweight, normal, overweight/obese) and associated sociodemographic factors among women of reproductive age (ie, 15–49 years) in Bangladesh stratified by urban–rural place of residence.

MATERIALS AND METHODS

Study design

We evaluated data from the Bangladesh Demographic Health Survey (BDHS) 2014. BDHS 2014 was the seventh nationally representative cross-sectional survey in Bangladesh. The sampling frame of the survey was determined from list of enumeration areas (EAs) of the 2011 National Population & Housing Census (NPHC). It used a two-stage stratified sampling design, where the first stage consisted of 600 EAs, with 207 in urban areas and 393 in rural areas from a list of EAs generated from NPHC of Bangladesh. The second stage of sampling involved a systematic selection of 30 households per EAs. From the total 17 500 surveyed households, one in every three households was randomly selected for anthropometry measurements. Samples were collected from all seven administrative divisions of Bangladesh. Survey design details, sampling strategy, sample size calculation, questionnaire, data collection procedures and results are described in more detail in the BDHS 2014 report.[30]

Outcome of interest

Body weight was the outcome of interest and was derived from the body mass index (BMI). BMI is calculated by dividing weight (in kilograms (kg)) with height (in metres squared (m^2)). We used Asian-specific BMI cut-off criteria to categorise participants as underweight (<18.5 kg/m^2), normal weight (18.5 to <23.0 kg/m^2) and overweight/obese (≥23.0 kg/m^2).[35] Anthropometric data (ie, height and weight) of participants were collected at home visits by trained field research staff using procedures standardised

in survey settings. Weight was measured using a solar-powered electronic scale and height was measured in centimetres by an adjustable measuring board. Each measurement tool was calibrated to maintain accuracy with precision to the nearest tenth decimal point.

Explanatory variables

The current study included demographic, socioeconomic and geographical factors to examine body weight of reproductive age women stratifying by rural–urban residence. Based on biological plausibility, data structure and published literature, following explanatory variables were included: age at the time of survey (ie, 15–29, 30–39 and 40–49 years); educational status (ie, no formal education, primary, secondary and college or above); lifetime number of pregnancies (ie, never pregnant, 1–4 times and ≥5 times); use of contraceptive method (ie, yes or no); current marital status (ie, married, widowed and divorced/separated); residence by division (ie, Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur and Sylhet) and household wealth quintile (ie, poorest, poorer, middle, richer and richest). The definition and categories of these explanatory variables are summarised in online supplementary material 1. The wealth index was calculated using principal component analysis of the selected assets (ie, household construction materials, types of water source and sanitation facilities, electricity and use of health services and other amenities). Initially, wealth quintiles are retrieved by assigning the household score to each respective household member, ordering each person in the population by his or her score and then subsequently recategorised into quintiles, each covering 20% of the population.[36–38] 'Strengthening the Reporting of Observational Studies in Epidemiology' statement was followed in writing the article (online supplementary material 2).

Statistical analysis

First, a descriptive analysis was conducted to determine sample characteristics according to bodyweight category and urban–rural residence. Reported results represent weighted counts and percentages, which accounts for the sampling design. Then, the prevalence (and 95% CI) of both underweight and overweight/obesity were determined. At last, unadjusted and adjusted logistic regression were conducted to obtain ORs and 95% CIs for associated factors. Only Adjusted ORs (AORs) with 95% CIs were reported. Variables with significance level of <0.2 were considered for inclusion in the final multivariable model. Multicollinearity was investigated with variance inflation factors. Stata V.14.0 (Stata) was used to analyse the data.

Ethical consideration

The survey ensured international ethical standards of confidentiality, anonymity and informed consent. This study is based on publicly available, deidentified DHS data. The electronic approval to use the dataset for this study was received from ICF international in September 2019.

Patient involvement

Patients and the public were not involved in the design and planning of the study.

RESULT

Characteristics of study sample

Table 1 illustrates the demographic characteristics of study participants stratified by urban–rural residence and body weight categories. A total weighted sample of 16 478 reproductive aged women (15–49 years old) were included in the analysis: 4685 women from urban areas and 11 793 women from rural areas. The majority of underweight women from both rural and urban regions were in the youngest age group (ie, 15–29 years old), with older age groups (ie, 30–39, 40–49 years old) more prominent among overweight/obese women in both regions. The proportion of contraceptive using women was slightly higher in urban regions compared with rural regions, 65.7% (n=3079) and 62.5% (n=7372), respectively. In both regions, more than 90% of women in each body weight category were married, with similar distributions among body weight groups. The proportion of women with no formal education was higher in rural regions, whereas the proportion of college or above education was higher in urban regions. In urban regions, about two-thirds of overweight/obese women were from the richest wealth quintile, 63.4% (n=1580); conversely, in rural regions, more than one-third of underweight women were from the poorest wealth quintile, 35.3% (n=878). The highest proportion of respondents were from Dhaka division in both regions.

Prevalence of underweight, normal weight and overweight/obesity according to place of residence and characteristics

Table 2 reports prevalence (with 95% CI) of body weight categories by various demographic characteristics according to urban–rural residence. Overall, more than half of urban women 53% (n=2493) and one-third of rural women 33% (n=3968) were overweight/obese. Around one-fifth of rural women (21%, n=2490) and almost one in eight urban women (12%, n=571) were underweight. The prevalence of underweight was higher in rural areas compared with urban areas across all the explanatory characteristics except for wealth quintile, where urban regions had a slightly higher prevalence for most wealth categories. The opposite phenomenon was observed for overweight/obesity, with the prevalence typically higher in urban regions in than rural regions.

Among age groups, the highest prevalence of overweight/obesity was observed among women aged 30–39 years in both regions: 63.8% (95% CI 59.9% to 67.6%) in urban regions, and 41.2% (95% CI 38.5% to 43.9%) in rural regions. A gradient effect was seen for educational level, with the prevalence of overweight/obese

Table 1 Sample characteristics according to body weight in urban and rural regions

Variables	Urban regions (n=4685)				Rural regions (n=11 793)			
	Underweight (n=571)	Normal (n=1622)	Overweight/ obese (n=2493)	Total	Underweight (n=2490)	Normal weight (n=5336)	Overweight/ obese (n=3968)	Total
Age (in years)								
15–29	333 (58.3)	868 (53.5)	899 (36.0)	2099 (44.8)	1319 (53.0)	2648 (49.6)	1439 (36.3)	5406 (45.8)
30–39	106 (18.5)	427 (26.3)	940 (37.7)	1473 (31.4)	590 (23.7)	1581 (29.6)	1521 (38.3)	3692 (31.3)
40–49	132 (23.2)	327 (20.2)	654 (26.2)	1113 (23.8)	581 (23.3)	1107 (20.7)	1008 (25.4)	2695 (22.9)
No of pregnancies in life								
Never pregnant	77 (13.5)	189 (11.7)	149 (6.0)	415 (8.9)	192 (7.7)	405 (7.6)	229 (5.8)	825 (7.0)
1–4	426 (74.7)	1285 (79.2)	2165 (86.9)	3876 (82.7)	1897 (76.2)	4133 (77.5)	3240 (81.7)	9270 (78.6)
≥5	68 (11.9)	148 (9.1)	178 (7.1)	393 (8.4)	401 (16.1)	798 (15.0)	499 (12.6)	1698 (14.4)
Contraceptive use								
No	225 (39.4)	568 (35.0)	813 (32.6)	1606 (34.3)	1079 (43.3)	1918 (35.9)	1424 (35.9)	4421 (37.5)
Yes	346 (60.6)	1054 (65.0)	1679 (67.4)	3079 (65.7)	1410 (56.7)	3418 (64.1)	2544 (64.1)	7372 (62.5)
Marital status								
Married	524 (91.7)	1463 (90.2)	2368 (95.0)	4355 (93.0)	2270 (91.2)	5070 (95.0)	3793 (95.6)	11 133 (94.4)
Widowed	28 (4.9)	80 (4.9)	77 (3.1)	184 (3.9)	143 (5.8)	159 (3.0)	129 (3.2)	431 (3.7)
Divorced/separated	19 (3.4)	79 (4.9)	48 (1.9)	146 (3.1)	76 (3.0)	107 (2.0)	46 (1.2)	228 (1.9)
Highest educational level								
No formal education	169 (29.7)	393 (24.3)	380 (15.2)	943 (20.1)	856 (34.4)	1562 (29.3)	895 (22.6)	3313 (28.1)
Primary	188 (32.9)	462 (28.5)	538 (21.6)	1188 (25.4)	806 (32.4)	1659 (31.1)	1157 (29.2)	3622 (30.7)
Secondary	175 (30.7)	586 (36.1)	1059 (42.5)	1820 (38.8)	747 (30.0)	1850 (34.7)	1635 (41.2)	4231 (35.9)
College or above	38 (6.7)	180 (11.1)	516 (20.7)	734 (15.7)	82 (3.3)	265 (5.0)	281 (7.1)	628 (5.3)
Wealth quintile								
Poorest	106 (18.5)	144 (8.9)	64 (2.6)	313 (6.7)	878 (35.3)	1387 (26.0)	479 (12.1)	2744 (23.3)
Poorer	65 (11.4)	120 (7.4)	69 (2.8)	254 (5.4)	710 (28.5)	1372 (25.7)	781 (19.7)	2862 (24.3)
Middle	101 (17.7)	211 (13.0)	212 (8.5)	525 (11.2)	527 (21.2)	1314 (24.6)	935 (23.6)	2775 (23.5)
Richer	158 (27.7)	516 (31.8)	567 (22.8)	1241 (26.5)	271 (10.9)	901 (16.9)	1083 (27.3)	2255 (19.1)
Richest	141 (24.7)	632 (38.9)	1580 (63.4)	2353 (50.2)	104 (4.2)	362 (6.8)	691 (17.4)	1156 (9.8)
Division								
Barisal	23 (4.1)	96 (5.9)	172 (6.9)	292 (6.2)	184 (7.4)	352 (6.6)	188 (4.7)	724 (6.1)
Chittagong	109 (19.1)	321 (19.8)	513 (20.6)	943 (20.1)	362 (14.5)	937 (17.6)	765 (19.3)	2064 (17.5)
Dhaka	250 (43.7)	728 (44.9)	1135 (45.5)	2112 (45.1)	804 (32.3)	1602 (30.0)	1260 (31.8)	3666 (31.1)

Continued

Table 1 Continued

Variables	Urban regions (n=4685)				Rural regions (n=11 793)			
	Underweight (n=571)	Normal (n=1622)	Overweight/ obese (n=2493)	Total	Underweight (n=2490)	Normal weight (n=5336)	Overweight/ obese (n=3968)	Total
Khulna	51 (8.9)	140 (8.7)	239 (9.6)	430 (9.2)	187 (7.5)	577 (10.8)	540 (13.6)	1304 (11.1)
Rajshahi	50 (8.7)	156 (9.6)	211 (8.5)	417 (8.9)	335 (13.5)	667 (12.5)	547 (13.8)	1550 (13.1)
Rangpur	43 (7.5)	103 (6.4)	146 (5.9)	292 (6.2)	346 (13.9)	821 (15.4)	454 (11.4)	1621 (13.7)
Sylhet	45 (7.9)	78 (4.8)	76 (3.1)	199 (4.3)	271 (10.9)	379 (7.1)	213 (5.4)	864 (7.3)

women increasing with higher educational attainment, and the greatest prevalence seen for urban women with college or above education: 70.2% (95% CI 65.5% to 74.6%),compared with 44.7% (95% CI 39.6% to 50.0%) among rural women. An inverse gradient effect was seen for underweight, with the prevalence of underweight increasing among women in both regions as educational level decreased. Similar patterns were seen in both regions for wealth quintile, with the prevalence of overweight/obesity increasing with increasing wealth and the prevalence of underweight increasing with decreasing wealth. Overall, the prevalence of overweight/obese and underweight by wealth quintile were similar for urban versus rural regions. Women from the upper two quintiles from both regions had the highest prevalence of overweight/obese, with the richest quintile at 67.2% (95% CI 64.2% to 70.0%) and 59.7% (95% CI 56.0% to 63.4%) for urban and rural regions, respectively. The prevalence of both non-normal weight categories also differed according to contraceptive use, marital status and division of residence.

Factors associated with nutritional status categories

Determinants of overweight/obesity

Our analysis revealed that increasing age, higher educational status and upper order wealth quintile has significant positive association with overweight/obesity among women from both regions of residence (table 3). In urban regions, compared with women 15–29 years old, the odds of overweight/obesity were increased about two times among women 30–39 (AOR 2.2, 95% CI 1.9 to 2.5) years old and 40–49 (AOR 2.4, 95% CI 2.0 to 2.9) years old. A similar association was also observed among women from rural regions. Urban women with college or above education were also two times more likely (AOR 2.2, 95% CI 1.7 to 2.8) to be overweight compared with women with no education. Women belonging to richest wealth quintile group had almost four times increased odds of being overweight/obese compared with their poorest counterparts in both urban (AOR 4.9, 95% CI 3.7 to 6.4) and rural (AOR 3.9, 95% CI 3.2 to 4.7) regions. Interestingly, divorced/separated (AOR: 0.4, 95% CI: 0.3 to 0.6) and widowed women (AOR 0.6, 95% CI 0.4 to 0.8) had an inverse association with overweight/obesity compared with the married women, a finding seen only in urban regions.

Determinants of underweight

Increasing age, higher educational status and upper order wealth quintile had a significant inverse association with underweight among women from both regions of residence, with the exception of educational level in urban women, for which there was no association (table 3). Older age group women (ie, 30 years and older) had almost half the odds of being underweight compared with younger women (15–29 years old). Women from rural regions with college or above education had a significantly negative association (AOR 0.7, 95% CI 0.5 to 1.0) with underweight compared with women with no

Table 2 Prevalence of underweight, normal weight and overweight/obesity according to place of residence and characteristics

	Urban regions (prevalence (95% CI))			Rural regions (prevalence (95% CI))		
Variable	**Underweight**	**Normal weight**	**Overweight/obese**	**Underweight**	**Normal weight**	**Overweight/obese**
Age (in years)						
15–29	15.9 (13.7 to 18.3)	41.3 (39.1 to 43.7)	42.8 (39.8 to 45.9)	24.4 (22.6 to 26.3)	49.0 (47.1 to 50.8)	26.6 (24.4 to 29.0)
30–39	7.2 (5.6 to 9.1)	29.0 (26.0 to 32.2)	63.8 (59.9 to 67.6)	16.0 (14.4 to 17.6)	42.8 (40.3 to 45.4)	41.2 (38.5 to 43.9)
40–49	11.9 (8.9 to 15.7)	29.4 (25.9 to 33.2)	58.7 (53.1 to 64.2)	21.6 (19.4 to 23.9)	41.1 (38.4 to 43.8)	37.4 (34.7 to 40.1)
No of pregnancies in life						
Never pregnant	18.5 (14.4 to 23.4)	45.6 (40.2 to 51.1)	35.9 (30.6 to 41.6)	23.2 (20.0 to 26.8)	49.0 (44.5 to 53.6)	27.8 (23.9 to 32.0)
1–4	11.0 (9.2 to 13.1)	33.1 (31.1 to 35.3)	55.9 (52.6 to 59.1)	20.5 (18.8 to 22.2)	44.6 (43.0 to 46.2)	35.0 (32.7 to 37.3)
≥5	17.3 (13.2 to 22.2)	37.5 (33.0 to 42.2)	45.2 (39.8 to 50.7)	23.6 (21.0 to 26.5)	47.0 (44.3 to 49.7)	29.4 (26.0 to 33.0)
Contraceptive use						
No	14.0 (10.9 to 17.7)	35.4 (32.1 to 38.8)	50.6 (46.1 to 55.1)	24.4 (22.4 to 26.6)	43.4 (41.2 to 45.6)	32.2 (29.2 to 35.4)
Yes	11.2 (9.5 to 13.3)	34.2 (31.9 to 36.6)	54.5 (51.3 to 57.8)	19.1 (17.9 to 20.5)	46.4 (44.7 to 48.1)	34.5 (32.6 to 36.4)
Marital status						
Married	12.0 (10.0 to 14.4)	33.6 (31.6 to 35.6)	54.4 (51.0 to 57.7)	20.4 (19.2 to 21.7)	45.5 (44.1 to 46.9)	34.1 (32.2 to 36.0)
Widowed	15.1 (10.1 to 21.9)	43.4 (34.7 to 52.4)	41.5 (33.6 to 50.0)	33.2 (24.3 to 43.6)	37.0 (29.9 to 44.6)	29.8 (23.5 to 37.1)
Divorced/separated	13.2 (8.5 to 19.9)	54.0 (45.7 to 62.0)	32.8 (25.9 to 40.6)	33.3 (26.0 to 41.4)	46.7 (37.0 to 56.6)	20.1 (14.6 to 27.0)
Highest educational level						
No formal education	18.0 (14.1 to 22.6)	41.7 (38.2 to 45.4)	40.3 (35.2 to 45.6)	25.8 (23.6 to 28.2)	47.1 (44.3 to 50.0)	27.0 (24.6 to 29.6)
Primary	15.8 (12.8 to 19.4)	38.9 (35.9 to 42.0)	45.3 (41.3 to 49.3)	22.2 (19.6 to 25.2)	45.8 (43.2 to 48.5)	31.9 (29.7 to 34.2)
Secondary	9.6 (8.1 to 11.4)	32.2 (29.2 to 35.4)	58.2 (54.5 to 61.8)	17.6 (15.9 to 19.5)	43.7 (40.9 to 46.6)	38.6 (36.1 to 41.2)
College or above	5.2 (3.5 to 7.6)	24.6 (20.6 to 29.0)	70.2 (65.5 to 74.6)	13.0 (10.1 to 16.5)	42.3 (37.4 to 47.3)	44.7 (39.6 to 50.0)
Wealth quintile						
Poorest	33.8 (26.0 to 42.6)	45.9 (40.0 to 51.9)	20.3 (14.6 to 27.7)	32.0 (29.1 to 35.0)	50.5 (48.0 to 53.1)	17.5 (15.0 to 20.2)
Poorer	25.6 (20.3 to 31.7)	47.3 (41.9 to 52.6)	27.1 (21.0 to 34.2)	24.8 (22.5 to 27.2)	47.9 (45.7 to 50.2)	27.3 (25.0 to 29.6)
Middle	19.3 (15.3 to 24.0)	40.3 (36.0 to 44.6)	40.5 (35.0 to 46.1)	19.0 (17.3 to 20.8)	47.3 (44.3 to 50.4)	33.7 (30.8 to 36.7)
Richer	12.7 (10.2 to 15.8)	41.5 (38.3 to 44.9)	45.7 (41.4 to 50.1)	12.0 (10.2 to 14.1)	40.0 (36.9 to 43.1)	48.0 (44.4 to 51.6)
Richest	6.0 (4.9 to 7.2)	26.8 (24.4 to 29.5)	67.2 (64.2 to 70.0)	9.0 (7.0 to 11.4)	31.3 (28.1 to 34.6)	59.7 (56.0 to 63.4)
Division						
Barisal	8.0 (4.6 to 13.7)	33.0 (29.8 to 36.4)	58.9 (52.1 to 65.5)	25.5 (22.1 to 29.1)	48.5 (46.0 to 51.1)	26.0 (22.6 to 29.7)
Chittagong	11.6 (9.4 to 14.1)	34.0 (29.8 to 38.5)	54.4 (50.0 to 58.8)	17.5 (15.2 to 20.2)	45.4 (41.6 to 49.3)	37.1 (32.7 to 41.6)
Dhaka	11.8 (8.3 to 16.6)	34.5 (31.1 to 38.0)	53.7 (47.4 to 59.9)	21.9 (18.9 to 25.3)	43.7 (40.8 to 46.6)	34.4 (29.6 to 39.5)
Khulna	11.8 (8.8 to 15.8)	32.6 (27.4 to 38.4)	55.5 (47.9 to 62.9)	14.3 (12.5 to 16.4)	44.3 (41.3 to 47.2)	41.4 (38.1 to 44.8)

Continued

Table 2 Continued

Variable	Urban regions (prevalence (95% CI))			Rural regions (prevalence (95% CI))		
	Underweight	Normal weight	Overweight/obese	Underweight	Normal weight	Overweight/obese
Rajshahi	11.9 (9.2 to 15.3)	37.4 (31.8 to 43.3)	50.7 (43.7 to 57.7)	21.6 (18.8 to 24.7)	43.1 (40.6 to 45.5)	35.3 (31.8 to 39.0)
Rangpur	14.7 (10.6 to 20.0)	35.4 (31.1 to 39.8)	49.9 (42.4 to 57.5)	21.3 (18.0 to 25.2)	50.6 (46.3 to 55.0)	28.0 (23.6 to 32.9)
Sylhet	22.6 (17.5 to 28.7)	39.1 (35.0 to 43.4)	38.3 (32.1 to 44.9)	31.4 (27.4 to 35.8)	43.9 (40.6 to 47.2)	24.7 (21.4 to 28.3)

education, whereas no such association was seen for urban women. Women belonging to the richest wealth quintile group had around 50% reduced likelihood of being underweight compared with their poorest counterparts in both urban (AOR 0.4, 95% CI 0.3 to 0.6) and rural (AOR 0.5, 95% CI 0.4 to 0.6) regions. Rural women who used contraceptives were found to have significantly decreased odds (AOR 0.8, 95% CI 0.7 to 0.9) of being underweight compared with contraceptive non-users; this finding was not significant for urban women. Women from Sylhet division in both urban (AOR 1.7, 95% CI 1.2 to 2.5) and rural regions (AOR 1.5, 95% CI 1.2 to 1.8) had increased likelihood of being underweight compared with women in Barisal division. The only division with reduced odds of underweight was for rural women in Khulna (AOR 0.7, 95% CI 0.6 to 0.9).

DISCUSSION

In this study, we investigated differences in prevalence and associated factors of underweight and overweight/obesity according to rural–urban place of residence among women of reproductive age in Bangladesh. We found that the prevalence of overweight/obesity was higher across most of the characteristics in urban regions compared with rural regions with the opposite scenario depicted for underweight prevalence in rural regions. In both regions, overweight/obesity was highly significantly associated with increasing age, higher educational attainment and higher wealth quintile. With the exception of educational level in urban women, each of these factors had an inverse relationship with being underweight in both regions.

The prevalence of overweight/obesity from the present study validates the prediction that by 2015 overnutrition could exceed undernutrition in Bangladesh.[23 39] Results from this study correspond to the national estimate of overweight/obesity prevalence of 39%, which is comparatively higher than another previous study using data from BDHS 2014.[40] Such discrepancy in estimates can be explained due to usage of different cut-off criteria for categorising body weight and chosen sociodemographic characteristics. Nonetheless, it highlights the growing prevalence of overweight/obesity among urban women in Bangladesh. The prevalence of overweight/obesity was comparatively greater in urban than rural women. Multiple factors likely contribute to the increased prevalence of overweight/obesity in urban populations, including the presence of modern communication facilities, increased availability of technology, easy accrual of energy-rich food, reduced levels of physical activity and adoption of sedentary lifestyle.[41–44] Studies reveal a higher prevalence of physical inactivity among Bangladeshi women compared with other women from South-Asian countries.[45] In our study, older women from both rural and urban regions had increased likelihood of being overweight/obese compared with younger women. This finding is consistent with studies from other Asian

Table 3 Factors associated with underweight and overweight/obesity according to place of residence[1]

	Underweight versus normal weight (AOR (95% CI))		Overweight/obesity versus normal weight (AOR (95% CI))	
Variables	Urban regions	Rural regions	Urban regions	Rural regions
Age (in years)				
15–29	Ref.	Ref.	Ref.	Ref.
30–39	0.6*** (0.5 to 0.7)	0.7*** (0.6 to 0.8)	2.2*** (1.9 to 2.5)	1.9*** (1.7 to 2.2)
40–49	0.7* (0.5 to 0.9)	0.7*** (0.6 to 0.9)	2.4*** (2.0 to 2.9)	1.9*** (1.6 to 2.2)
No of pregnancies in life				
Never pregnant	Ref.	Ref.	Ref.	Ref.
1–4	0.8 (0.6 to 1.1)	0.9 (0.8 to 1.2)	1.9*** (1.5 to 2.3)	1.2 (1.0 to 1.5)
≥5	1.1 (0.7 to 1.6)	1.0 (0.8 to 1.3)	1.5* (1.1 to 2.1)	1.0 (0.8 to 1.2)
Contraceptive use				
No	Ref.	Ref.	Ref.	Ref.
Yes	0.9 (0.7 to 1.1)	0.8*** (0.7 to 0.9)	0.9 (0.8 to 1.1)	1.0 (0.9 to 1.1)
Marital status				
Married	Ref.	Ref.	Ref.	Ref.
Widowed	1.3 (0.8 to 1.9)	1.4* (1.0 to 1.8)	0.6** (0.4 to 0.8)	1.0 (0.8 to 1.3)
Divorced/separated	0.9 (0.6 to 1.4)	1.2 (0.9 to 1.7)	0.4*** (0.3 to 0.6)	0.8 (0.6 to 1.2)
Highest educational level				
No formal education	Ref.	Ref.	Ref.	Ref.
Primary	1.0 (0.8 to 1.3)	0.9* (0.8 to 1.0)	1.2* (1.0 to 1.5)	1.3*** (1.1 to 1.5)
Secondary	0.8 (0.6 to 1.1)	0.8* (0.7 to 1.0)	1.6*** (1.3 to 1.9)	1.4*** (1.2 to 1.6)
College or above	0.8 (0.5 to 1.2)	0.7* (0.5 to 1.0)	2.2*** (1.7 to 2.8)	1.4** (1.1 to 1.7)
Wealth quintile				
Poorest	Ref.	Ref.	Ref.	Ref.
Poorer	0.8 (0.5 to 1.1)	0.9* (0.8 to 1.0)	1.2 (0.9 to 1.7)	1.3*** (1.1 to 1.5)
Middle	0.8 (0.6 to 1.0)	0.7*** (0.6 to 0.8)	2.1*** (1.5 to 2.7)	1.6*** (1.4 to 1.9)
Richer	0.5*** (0.4 to 0.7)	0.5*** (0.4 to 0.6)	2.5*** (1.9 to 3.3)	2.5*** (2.1 to 2.9)
Richest	0.4*** (0.3 to 0.6)	0.5*** (0.4 to 0.6)	4.9*** (3.7 to 6.4)	3.9*** (3.2 to 4.7)
Division				
Barisal	Ref.	Ref.	Ref.	Ref.
Chittagong	1.3 (0.9 to 1.8)	0.8 (0.7 to 1.0)	0.9 (0.7 to 1.2)	1.3** (1.1 to 1.6)
Dhaka	1.1 (0.8 to 1.6)	1.0 (0.8 to 1.2)	0.8* (0.6 to 1.0)	1.3** (1.1 to 1.6)
Khulna	1.2 (0.8 to 1.7)	0.7*** (0.6 to 0.9)	1.0 (0.8 to 1.3)	1.5*** (1.3 to 1.8)
Rajshahi	1.0 (0.7 to 1.4)	1.0 (0.8 to 1.2)	0.8 (0.7 to 1.1)	1.4*** (1.2 to 1.7)
Rangpur	1.2 (0.8 to 1.7)	0.9 (0.7 to 1.0)	1 (0.8 to 1.3)	1.0 (0.8 to 1.2)
Sylhet	1.7** (1.2 to 2.5)	1.5*** (1.2 to 1.8)	0.6*** (0.5 to 0.8)	0.9 (0.8 to 1.1)

Normal weight was the reference group; adjusted for all variables in the column.
*P<0.05, **P<0.01, ***P<0.001.
AOR, adjusted OR.

countries (eg, India), which suggests older women are less physically active and are more likely to consume an obesogenic diet.[46] Possibly due to age-related changes in body composition, women after 30 years of age are predisposed to be overweight compared with the younger age group.[47 48]

The presented analysis further validates that higher socioeconomic status (ie, higher educational attainment and wealth status) among both regions of residence accompanies increased prevalence of overweight/obesity and lower prevalence of underweight. These findings are consistent with prior studies conducted both

in Bangladesh and Nepal.[31 49–51] Women with a higher socioeconomic status tend to engage in sedentary workplace activities, shifting from manual work to less physically intensive tasks, which considerably reduces physical activity levels.[52] Baecke *et al* showed that while educational status more positively affects leisure time, it negatively affects habituated physical activity.[53] Moreover, the complex social changes brought about by urbanisation, globalisation and economic advancement have contributed to a dramatic shift in Asian diets towards the energy-dense, protein-rich Western diet, thus further accelerating this pattern.[54] As with increasing financial security, women belonging to higher wealth quintiles tend to adopt sedentary lifestyles alongside increased consumption of energy-dense, nutrient-poor foods, factors which also increase risk of being overweight/obese. Urban women may also tend towards this pattern of food consumption and lifestyle, factors which are likely reflected in findings from this study. Finally, all these socioeconomic factors (ie, increased income, wealth status and education) can significantly elevate the prevalence of overweight/obesity, consequently increasing burden of non-communicable diseases.[55–57]

Women with increasing age, increasing number of pregnancies and contraceptive use had higher prevalence of overweight/obesity and a lower prevalence of underweight; however, contraceptive use was not significantly associated with overweight/obesity. Age and number of pregnancies are correlated with one another, as women with higher age are more likely to have a higher number of pregnancies. Hormonal changes associated with childbearing could cause weight gain among women.[58] Moreover, women with increasing age/pregnancy are also more likely to take hormonal contraceptives, a factor which is thought to be associated with weight gain. Similar to our analysis, a recent systematic review found the evidence insufficient for this association.[59]

This study has several major strengths and limitations. To our knowledge, this is the first nationally representative epidemiological study of Bangladeshi women of reproductive age to investigate the prevalence and determinants of body weight status using Asian BMI cut-offs with stratification by rural–urban residence. As a result, the findings of this study are generalisable to the target population of Bangladesh. However, due to cross-sectional nature of the data, assumption of causal attributes between explanatory determinants and outcomes is of limited value. Asian BMI cut-offs were used to categorise the analysed sample, which may overestimate overweight/obesity group when compared with WHO-recommended cut-offs. Moreover, data on known risk factors of undernutrition and overnutrition including the dietary intake, physical activity, sedentary behaviour, visceral adiposity and cardiovascular diseases risk factors such as dyslipidaemia, hypertension, diabetes were not available in the BDHS dataset, therefore, could not be included in the multivariable model. Although the study has a large sample size that covered the rural and urban regions of the entire country, including mainly the married women may limit the generalisability of the findings to all women within the reproductive age in Bangladesh.

CONCLUSIONS

This study demonstrates the considerable presence of the 'double burden' of underweight and overweight/obesity in rural and urban Bangladeshi women of reproductive age using nationally representative data. Approximately half of urban women were overweight/obese and one in five rural women were underweight. Increasing age, higher educational attainment and higher order wealth quintile were significantly associated with increased odds of overweight/obese for both urban and rural regions. Conversely, lower age and wealth quintile were significantly associated with increased odds of underweight for both regions. The burgeoning population with non-normal weight status necessitates comprehensive public awareness and cost-effective operational health interventions to be adopted in national health policy. In addition, the prevailing substantial prevalence of underweight young women in both rural and urban regions calls for prioritisation of targeted strategies to mitigate adverse health impacts, especially among newborns and mothers of low socioeconomic status.

Author affiliations
[1]Respiratory and Enteric Infections Department, Infectious Disease Division, International Centre for Diarrhoeal Disease Research Bangladesh, Dhaka, Bangladesh
[2]Centre for Non-Communicable Diseases and Nutrition, BRAC James P Grant School of Public Health, BRAC University, Mohakhali, Dhaka, Bangladesh
[3]Department of Epidemiology and Biostatistics, Arnold School of Public Health, University of South Carolina, Columbia, South Carolina, USA
[4]Department of Epidemiology and Public Health, University of Maryland School of Medicine, Baltimore, Maryland, USA

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ORCID iDs
Mohammad Rashidul Hashan http://orcid.org/0000-0002-1627-4976
Rajat Das Gupta http://orcid.org/0000-0002-7680-676X
Gulam Muhammed Al Kibria http://orcid.org/0000-0002-7037-6658

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