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Abstract

This study specifies and estimates a model of the determinants of unhealthy BMI categories separately for child-bearing urban and rural women aged 15-49 years old, employing data from multiple waves (2004-18) of the nationally representative Demographic and Health Surveys (DHS) of Bangladesh. Using multilevel nested logit empirical models, we detect robust heterogeneous associations of unhealthy BMI categories with individual-level socioeconomic variables and cluster (community and region) factors. After removing cluster effects to obtain more precise estimates, we document that underweight status risk is inversely related to years of education for urban and rural women. In contrast, a direct relationship exists between the risk of being overweight and years of education for both urban and rural women. The risk of being obese is positively associated with years of education only for urban women. Women's employment status at the extensive margin lowers the risk of being overweight and obese in both cohorts. Women are less likely to be underweight and more likely to be overweight and obese as their household's socioeconomic status improves. Study findings could inform both policy and practice aimed at reducing economic burdens of the unhealthy BMI to achieve important targets such as sustainable development goals.

Introduction

- Almost one-third of the global population experiences some forms of extreme malnutrition (WHO 2016a), with more than 30% overweight or obese, and over 600 million underweight adults (WHO 2016b).
- Overweight and obesity are increasingly a more pronounced health problem in many low-middle-income countries among different segments of the population.
- Obesity (BMI \geq 30) is particularly known to incubate several cardiometabolic diseases, including high blood pressure and diabetes, whereas underweight (BMI<18.5) is linked to lower economic productivity and contributes to higher morbidity and mortality rates (Black et al. 2013).
- The economic consequence of obesity includes lower wages and higher medical costs that impose negative externalities through higher health insurance premiums (Cawley 2015).
- Therefore, effectively controlling disorders linked to unhealthy BMI could curb healthcare cost growth, increase productivity, and raise long-term economic growth.
- While several studies analyze the drivers of child nutritional change in several developing countries, including Bangladesh (Headey 2013; Headey et al. 2015; Webb and Block 2004), there is a dearth of studies, largely in economics, focused on the determinants of unhealthy BMI categories in women of child-bearing age in these countries by urban and rural areas.
- All past studies (Biswas et al. 2017; Shafique et al. 2007; Tanwi et al. 2019) combined overweight and obesity as a single indicator. To our knowledge, this is the only study in the context of Bangladesh that separately fit models to unmask differential risks associated with overweight and obesity.
- Undetected geographical variations in the prevalence of unhealthy BMI could delay the craft of context-specific policy directions and increase the likelihood of health system-generated socioeconomic disparity.
- This paper attempts to fill the literature gap by analyzing economic variables that explain unhealthy BMI outcomes in women of child-bearing age in Bangladesh.

Methods and Materials

- This paper constructs, for empirical econometric estimation, a model of the determinants of underweight, overweight, and obese conditions among women of child-bearing aged 15-49 years in Bangladesh adopting multilevel nested modeling approach and using the latest five rounds (2004-2018) of the Bangladesh Demographic and Health Surveys (BDHS) conducted by the Demographic and Health Survey (DHS) program.
- Standard logit models tend to bias the parameter estimates of the covariates when analyzing multilevel data. Ignoring the nested structure of the data leads to the biased statistical significance of a coefficient.
- Performing multilevel analysis allows us to do the simultaneous investigation of the associations of the cluster (community and region) and individual-level variables with individual-level outcomes, i.e., unhealthy BMI outcomes, while accounting for the dependence of observations within groups.
- We remove the cluster (i.e., community and region) effects from the data in order to get more precise estimates on the relationships between economic determinants and unhealthy BMI outcomes among women of child-bearing age.
- We begin by estimating the following two-level model allowing for random effects due to community:

$$\log\left(\frac{P_{ijt}^N}{1-P_{ijt}^N}\right) = \alpha + \beta X_{ijt} + u_j + R + T + e_{ijt} \quad (1)$$

Next, we extend our estimation to the following three-level model allowing for the random effects due to the region and the community nested within the region:

$$\log\left(\frac{P_{ijkt}^N}{1-P_{ijkt}^N}\right) = \alpha + \beta X_{ijkt} + u_k + v_{j(k)} + T + e_{ijkt} \quad (2)$$

where $P_{ijkt}^N = P(Y_{ijkt}^N = 1 | X, u_k, v_{j(k)}, T)$ is the probability that individual i within community j nested within region k at time t experiences an unhealthy BMI indicator N . The region-specific component u_k , a region random effect, is assumed to follow a normal distribution with mean zero and variance $\sigma_{u_k}^2$. Similarly, the community-specific component nested within the region $v_{j(k)}$, a random Community effect, presumably follows a normal distribution with mean zero and variance $\sigma_{v_{j(k)}}^2$.

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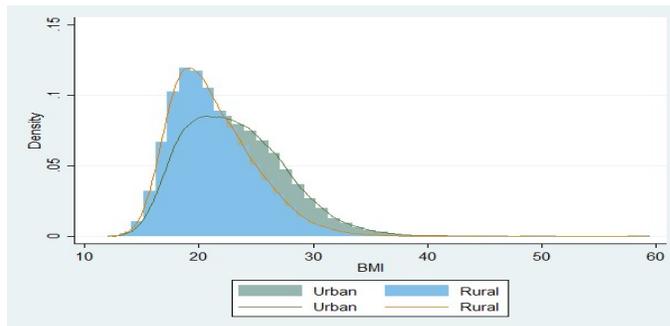


Chart 1. Distribution of BMI of women of child-bearing age in Bangladesh.

Results

- We find evidence of heterogeneity in BMI across urban and rural residents. Additionally, significant community and region effects are evidenced in both urban and rural samples.
- An additional year of education is associated with 0.6 and 0.5 percentage point reductions in the risk of being underweight for urban and rural women, respectively.
- While an additional year of education is associated with an increased risk of being overweight for urban and rural women by 0.5 and 0.3 percentage points, respectively, and is linked with a 0.1 percentage point increased risk of being obese for urban women.
- Compared to their unemployed peers, employed women are 2.9 and 0.9 percentage points less likely to be overweight in urban and rural areas, respectively. The magnitudes of association with the risk of being obese decrease to a 2-percentage point reduction for urban women and a 0.1 percentage point reduction for rural women.
- Urban and rural women from the richest households have approximately 13 and 18 percentage points lower risks of being underweight, respectively, compared to their poorest peers.
- In contrast, urban and rural women from the richest households have 17.2 and 10.8 percentage points higher risks of being overweight, respectively, compared to those from the poorest households.
- Interestingly, the marginal effects on the risk of being obese drop to a 6.4-percentage point increase for urban women and a 2.5-percentage point increase for rural women.
- We examine several subsamples and specifications as robustness checks to conceptually and statistically check validity of our main results for all three outcomes.
 - Repeating the main analysis splitting the sample into two age groups: 15-34 and 35-49
 - A heterogeneity analysis conducted by marital status to further evaluate robustness of our findings.
 - The robustness of our baseline estimates is indirectly tested against susceptibility of endogeneity by elimination of certain controls including fertility, demographic variables, and partner characteristics on the grounds that these might be potentially endogenous (Headey et al. 2015).
- Our findings from the baseline sample are found robust to all subsamples and alternative specifications.

Discussion & Conclusion

- The estimated coefficients of the multilevel nested logit models reveal significant differences between urban and rural subsamples for the women of child-bearing age.
- In contrast to existing work, fitting the separate unhealthy BMI (underweight, obese, underweight) models for rural and urban areas reveals policy gaps capable of unmasking the growing risks associated with unhealthy BMI.
- Effective behavior change communication (BCC) interventions through school health programs can be implemented to educate adolescent girls on nutrition knowledge, healthy dietary practices, and indoor (e.g., rope skipping) and outdoor physical exercises.
- Underweight is prevalent both in low and high socio-economic households but the Bangladeshi health system dominantly emphasizes on rural households. Disparity in resource allocation and misalignment of funds between rural and urban settings could increase the gaps in social and economic indices of the country.
- Our estimates indicate that overweight and obesity are more concentrated among women from high SES. Family-based lifestyle intervention such as visit to dietician on a regular basis could be advised to urban rich women as it could result in a significant weight loss than getting lifestyle advice annually from a dietician.

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