Do burdens of underweight and overweight coexist among lower socioeconomic groups in India?1–4

SV Subramanian, Jessica M Perkins, and Kashif T Khan

ABSTRACT

Background: The coexistence of underweight and overweight in rapidly developing economies is well recognized. However, less is known about the socioeconomic patterning of underweight and overweight as economies move through the epidemiologic transition.

Objective: The objective was to assess whether burdens of underweight and overweight coexist among lower socioeconomic groups in India.

Design: Repeated cross-sectional analyses were conducted in nationally representative samples of 76,514 and 80,054 women aged 15–49 y drawn from the 1998–1999 and 2005–2006 Indian National Family Health Survey, respectively. Body mass index (in kg/m²) was used to measure weight status. We also calculated a ratio of the number of underweight women (<18.5) divided by the number of overweight women (≥24.9). Indicators of socioeconomic status (SES) included wealth and education.

Results: Although the ratio of underweight to overweight women decreased from 3.3 in 1998–1999 to 2.2 in 2005–2006, there were still considerably more underweight women than overweight women. It was only in the top wealth quintile and in groups with higher education that there was a slight excess of overweight women as compared with underweight women. There was a strong positive relation between SES and body mass index at both time points and across urban and rural areas. A positive relation between SES and body mass index was also observed for men in 2005–2006.

Conclusions: The distribution of underweight and overweight in India remains socially segregated. Despite rapid economic growth, India has yet to experience a situation in which underweight and overweight coexist in the low-SES groups. Am J Clin Nutr 2009;90:369–76.

INTRODUCTION

Rapidly growing economies often experience coexistence of underweight and overweight problems, referred to as the double burden of nutrition (1, 2). There is, however, less empirical certainty on the socioeconomic patterning of the double nutritional burden within a country. The commonly held perspective is that before a nutritional transition, overweight and underweight tend to be concentrated in the high- and low-socioeconomic-status (SES) groups, respectively. During the transition, however, the overweight burden is posited to shift to the low-SES groups, even though the underweight burden remains, which exposes the low-SES groups to a double nutritional burden (3). To our knowledge, only 2 studies have examined changes in the SES-weight gradient over a period of time for the same country. In a study of income-specific trends in obesity in Brazil, it was shown that obesity prevalence increased only among women in the bottom 2 income quintiles between 1989 and 2003 (4). The weight-income gradient, however, was still positive. The other study analyzed trends in body mass index (BMI; in kg/m²) from 1989 to 2000 among rural Chinese adults and showed that the prevalence of overweight or obesity increased by ≥8.8% (5).

Notably, in both China and Brazil, the proportion of the population that was underweight was not large: 6.5% in China in 2000 (5) and 10.6% in Brazil in 1989 (6). The particular trajectory of the SES–nutrition status relation in countries facing a substantial burden of underweight remains unclear. India has one of the highest underweight burdens in the world and is beginning to experience the emerging problem of overweight (7–10). Previous studies from India, using data before 2000, have shown a positive SES-weight relation and that the distribution of underweight and overweight was concentrated among low-SES and high-SES individuals, respectively (11, 12). Recently, it has been argued that the association between SES and cardiovascular disease risk factors (including BMI) in India has switched to an inverse relation, mirroring the patterns observed in developed countries (13). Using 2 large, nationally representative samples, we examined the changes in the socioeconomic patterning in underweight and overweight among adult women in India between 1998–1999 and 2005–2006 and the socioeconomic patterning in BMI among men in 2005–2006. During this period, India was one of fastest growing economies.

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2 This study was reviewed by the Harvard School of Public Health Institutional Review Board and was considered exempt from full review because it was based on an anonymous public use data set with no identifiable information on the survey participants.

3 SVS was supported by the National Institutes of Health Career Development Award (NHLBI K25 HL081275).

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in the world (14), even though income inequality within India also increased (15).

METHODS

Data

The analyses were based on the representative, cross-sectional 1998–1999 Indian National Family Health Survey (INFHS-2) of 90,303 women in 26 states and the 2005–2006 Indian National Family Health Survey (INFHS-3) of 124,385 women in 29 Indian states (16, 17). The surveys included women aged between 15 and 49 y and were conducted in 1 of the 18 Indian languages in respondents’ homes with >95% response rates. We restricted our sample to ever-married women (because the first survey had only interviewed ever-married women) who were neither pregnant nor had tuberculosis (1998–1999: n = 83,216; 2005–2006: n = 87,450). After excluding women with missing information on height or weight (1998–1999: n = 6016; 2005–2006: n = 3627) or on any of the predictors considered in the analysis (age, marital status, religion, caste, education, wealth, occupation, place, and parity) (1998–1999: n = 686; 2005–2006: n = 3769), the final analytic sample consisted of 76,514 women for 1998–1999 and 80,054 women for 2005–2006; ∼8% of each sample was missing information. As part of a sensitivity analysis, we also examined the social patterning of BMI among men for survey year 2005–2006 (n = 66,396). Data on BMI for men were not collected for survey year 1998–1999.

Outcome

BMI, calculated as weight in kilograms divided by height in meters squared, was used to assess weight status. Weight was measured by using a solar-powered scale with an accuracy of ±100 g. Height was measured with an adjustable wooden measuring board that was designed to provide accurate measurements (to the nearest 0.1 cm) in the context of a developing-country field situation (18). The World Health Organization conventions appropriate for Asian populations (19) were used to identify BMI cutoffs: <18.5 (underweight), 18.5–22.9 (normal weight), 23–24.9 (which we refer to as “at risk of overweight” or “preoverweight”), 25–29.9 (overweight), and ≥30 (obese).

Indicators of socioeconomic status

We focused on 2 measures of SES: standard of living (hereafter referred to as wealth) and education. Wealth was defined in terms of ownership of material possessions by the household (20), with each adult assigned a wealth score based on a combination of 33 different household characteristics that were weighted according to a factor analysis procedure and divided into quintiles (21, 22). The quintile cutoffs were survey-time dependent. We used significant milestones in the formal Indian education system to create the following categories of education: 0 y (illiterate), 1–5 y (primary), 6–8 y (secondary), 9–12 y (higher), 13–15 y (college), and >15 y (postgraduate).

Covariates

Age, religion, caste, occupation, location (urban or rural), parity, and state of residence were included as covariates. Caste identification was based on the head of household and was grouped as scheduled caste, scheduled tribe, other backward class, or the general caste. Scheduled castes are those whose members have suffered the greatest burden of deprivation within the caste system (23). Scheduled tribes include ∼700 officially recognized social groups that have historically been geographically and socially isolated and represent the “indigenous” groups in India. (24) “Other backward class” is a legislatively defined group representing those who have historically suffered significant deprivation, but not as severe as scheduled castes and tribes. The general class is a residual category containing those not identifying themselves as members of legislatively recognized marginalized classes and constitutes the “high” caste groups.

Statistical analysis

We calculated the weighted prevalence of underweight, preoverweight, overweight, and obese within each of the predictors using the national weights assigned by the cluster design at the Primary Sampling United (PSU) level, as presented in Table 1. We also calculated an underweight-to-overweight ratio as the weighted proportion of underweight women (BMI < 18.5) divided by the proportion of overweight women (BMI ≥ 24.9). A ratio of 1 indicated parity in the number of underweight and overweight women in a given population. We compared the underweight-to-overweight ratio across wealth quintiles and education categories for 1998–1999 and 2005–2006.

We also estimated weighted, multivariable, linear regression models to assess the independent effects of wealth and education on BMI and how the magnitude of these effects changed over time after the covariates were controlled for. We also estimated stratified models by urban and rural areas. Given the inherent hierarchical structure of the data (women within PSU within state), multilevel regression models accounted for clustering at the PSU level by including a random effect for PSU and addressed clustering at the state level by including state fixed effects. We also estimated multivariable, unordered, multinomial logistic regression models to compare independent effects of wealth and education on the risk of being in 1 of the 5 BMI categories, with BMI 18.5–22.9 used as the reference. Because the patterns between modeling BMI as a linear outcome and as an outcome with multiple categories were generally similar, we presented the results from the linear regression models in the main text, and the results from the multinomial models are available as online supplementary material (see Supplemental Table 1 under “Supplemental data” in the online issue).

RESULTS

The prevalence of underweight women decreased by only 3 percentage points (from 36% in 1998–1999 to 33% in 2005–2006) and the combined prevalence of preoverweight, overweight, and obese women increased by 5.6 percentage points (from 18.8% in 1998–1999 to 24.4% in 2005–2006) (Figure 1). The prevalence of overweight women increased by 3 percentage points to 11.4%, and the prevalence of obese women increased by 1.1 percentage points to 3.5%. The percentage of adult women in the normal BMI range fell by 2.4% to 42.9%.

In 1998–1999, there were 3.3 (95% Cl: 3.2, 3.4) overweight women for every 1 overweight woman across India as compared...
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(Continued)
with 2.2 (95% CI: 2.16, 2.3) underweight women for every 1 overweight woman in 2005–2006. The underweight-to-overweight ratios across the 5 wealth quintiles for 1998–1999 and 2005–2006 are shown in Figure 2. There were substantially more underweight women than overweight women in every quintile except for the top wealth quintile in both time periods. In 2005–2006, the underweight-to-overweight ratio ranged between 24.79 in the bottom wealth quintile and 1.27 in the fourth quintile. In the top wealth quintile, there were more overweight than underweight women in both time periods. There was also an inverse relation between the underweight-to-overweight ratio and educational status; more education was associated with a lower number of underweight women than of overweight women in both time periods (see Supplemental Table 2 under “Supplemental data” in the online issue).

In both time periods, the predicted relation between BMI and wealth was positive and strong (Table 2). The BMI differential between women in the lowest wealth quintile and women in the highest wealth quintile, regardless of location, was larger in 2005–2006 (3.11) than in 1998–1999 (2.75). Education was also positively associated with BMI; in 1998–1999, women with a college education were 0.62 heavier than those with no education, regardless of location. In 2005–2006, the same differential was 0.47. The positive association between education and BMI was also observed within the urban populations at both time periods, but the gradient was weaker than the gradient observed when wealth was used. In rural areas, the relation between categories of education and BMI was not consistent, although the relation between years of schooling and BMI was statistically significant (P value, 0.001).

We additionally examined the social patterning of BMI for men for survey year 2005–2006 and found a strong positive association between wealth and BMI among men (Figure 3; see Supplemental Table 3 under “Supplemental data” in the online issue).

**DISCUSSION**

Between 1998–1999 and 2005–2006, the positive and strong association between SES and BMI did not change. The double weight burden in India, thus, remains socially segregated. In both rural and urban areas, high-SES women were substantially more likely to be overweight, whereas low SES women presented with the burden of underweight. Even though the ratio of underweight to overweight women decreased from 1998–1999 to 2005–2006, there were still substantially more overweight women than underweight women. The marginal excess of overweight than of underweight women was only observed among high-SES women.

A higher prevalence of overweight among high-SES women has been postulated to be linked to cultural norms that may favor fat body shapes (25). Our sensitivity test finding of a weak interaction between women’s age and SES suggests that the positive association between BMI and SES was observed at every age and indirectly suggests that higher BMI among high-SES women could also reflect beliefs and social expectations concerning body size, although this is likely to be less prevalent among younger women. Cultural practices concerning food and physical activity are also possible explanations for the higher BMI among high-SES women. It has been shown that higher-

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**TABLE 1** (Continued)

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<td>46,718</td>
<td>14,598 (31.7)</td>
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<td>15,622 (44.5)</td>
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<td>Educated</td>
<td>60,684</td>
<td>10,656 (17.5)</td>
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<tr>
<td>Urban</td>
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<tr>
<td>Rural</td>
<td>45,743</td>
<td>20,954</td>
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income groups in India consume a diet containing 32% of energy from fat compared with 17% in lower-income groups (26). It is possible that high-SES women in India still face multiple barriers to engaging in physical activity and eating healthy despite having more knowledge about healthy food, healthy behavior, and resources (27).

A recent study from India, which examined the association between educational status and cardiovascular disease risk factors in industrial populations, concluded that lower socioeconomic groups were increasingly vulnerable to cardiovascular disease risk factors (13). Notably, even in this study, a significantly higher BMI was observed for those with higher education than for those with lower education, and the prevalence of obesity was >2.5 times that among those with higher education than among those with low or no education (13). Similarly, although the prevalence of overweight had increased for a nationally representative sample of urban poor and rural women in Bangladesh from 2000 to 2004, the risk of being overweight among these women was much greater in those with higher education than in women with no education (28). Our findings differ, however, from studies conducted in Brazil and China, where the prevalence of overweight increased among women in the 2 bottom wealth quintiles and among adults living in rural areas, respectively, as noted in the introduction (4, 5). Moreover, in 1997 in a developed region of Brazil, low-income women were more at risk of obesity and underweight than were high-income women—a change from 1975 and 1989 (29). It is possible that the lack of evidence indicating a double weight burden among low-SES women in India in 2005–2006 could have been because India’s economic status had not changed. By 2005, India was still a low-income country per World Bank’s classification, which suggests that a nutritional transition has yet to occur. Furthermore, the relatively shorter time frame of our study may also be a possible reason for not observing the crossover over in the SES-BMI relation.

It has been argued that even low-income countries increasingly face the double burden of infectious disease and cardiovascular disease risk factors (30). Although this observation is partially
true for India, which may necessitate a rethinking of the “diseases of affluence” and “diseases of poverty” paradigm (30), our findings suggest that the double burdens of underweight and overweight are not concentrated in the same population groups within India. Instead, overweight is a disease that primarily afflicts the affluent in India. The social segregation of the underweight and overweight burdens is likely to continue because, even with economic growth (which provides the immediate opportunity to consume more by increasing the standard of living), the distribution of the growth has remained extremely unequal (15). The social patterning of weight status, therefore, will closely approximate the maldistribution of income and other resources (11).

A slow increase in the prevalence of overweight in India accompanied by virtually no decrease in the prevalence of underweight seems to be the epidemiologic description of weight status for India. Without undermining the emerging concerns related to overweight in India (31), addressing the unfinished nutritional agenda regarding underweight has a moral and policy urgency. Being underweight remains the greatest risk factor for disease, disability, and mortality (32). Although children born to undernourished mothers, provided the children survive, may be

### TABLE 2

Weighted and adjusted multilevel linear regression coefficients and SEs for wealth and education predicting BMI for women aged 15–49 y in 1998–1999 \((n = 76,514)\) and 2005–2006 \((n = 80,054)\)^1

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<td>Second quintile</td>
<td>0.04</td>
<td>0.05</td>
<td>0.17^2</td>
<td>0.05</td>
<td>0.81^2</td>
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<tr>
<td>Third quintile</td>
<td>0.33^2</td>
<td>0.06</td>
<td>0.61^2</td>
<td>0.05</td>
<td>1.81^2</td>
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<td>Fourth quintile</td>
<td>0.98^2</td>
<td>0.06</td>
<td>1.47^2</td>
<td>0.06</td>
<td>2.55^2</td>
<td>0.13</td>
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<tr>
<td>Top quintile</td>
<td>2.75^2</td>
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<td>0.07</td>
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<td>1–5 y</td>
<td>0.22^2</td>
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<td>0.30^2</td>
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<td>0.40^2</td>
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<td>6–8 y</td>
<td>0.36^2</td>
<td>0.06</td>
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<td>9–12 y</td>
<td>0.42^2</td>
<td>0.06</td>
<td>0.37^2</td>
<td>0.05</td>
<td>0.46^2</td>
<td>0.12</td>
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<td>13–15 y</td>
<td>0.70^2</td>
<td>0.11</td>
<td>0.33^2</td>
<td>0.09</td>
<td>0.26</td>
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<td>&gt;15 y</td>
<td>0.62^2</td>
<td>0.17</td>
<td>0.47^2</td>
<td>0.12</td>
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^1 The reference (ref), or intercept, is a married other-caste Hindu woman 25–29 y of age with no education, is in the bottom quintile of wealth, and works as a homemaker in a rural area with no children in Uttar Pradesh.

^2 \(p < 0.001\).

^3 \(p < 0.1\).

^4 \(p < 0.05\).

^5 \(p < 0.01\).

**FIGURE 3.** Weighted and adjusted multilevel linear regression coefficients and SEs of wealth predicting BMI for men and women aged 15–49 y in India in 2005–2006 \((n = 66,393\) and \(80,054\), respectively).
more likely to succumb to diabetes, cardiovascular disease, or other chronic diseases in adulthood (33), an alternative intergenerational cycle of growth failure also needs attention; mothers with energy deficiency are more likely to give birth to low-weight infants, which leads to child growth failure and adverse social and educational outcomes, which in turn lead to underweight in adulthood (34). For instance, shorter maternal stature—a marker of cumulative nutritional deficiency—has been associated with child mortality and anthropometric failure in India (35). Recent prospective cohort studies from urban India suggested a null association between overweight and mortality (36, 37), whereas there remained a strong effect of underweight on mortality, independent of SES.

We should note that a given BMI may confer a greater risk of obesity-related diseases among Indians than in populations in which the BMI standards were initially developed (38). Although this questions the relevance of BMI as a measure of weight status (39), BMI is the most widely available measure for studying weight status in populations, especially in those in which a substantial fraction of the population remains undernourished. Furthermore, the association between SES and BMI should not be interpreted in unidirectional causal terms, because it is likely to be a reciprocal association. The motivation in this study was to assess the pattern of the double burden of weight status rather than to ascertain the causal association between SES and BMI. Finally, our analysis pertaining to changes in the social distribution of BMI was restricted to young-to-middle aged women, even though a cross-sectional analysis of social distribution of BMI among men showed similar patterns.

In summary, the lack of transition of the overweight burden to low-SES groups might signal that India is in the early stages of the nutrition transition. Alternatively, it may indicate that India faces a different nutrition trajectory given the unusually high proportion of underweight women in India relative to many of the developing countries that have experienced or are experiencing the nutrition transition. Regardless, systematic and frequent monitoring and surveillance of the social trajectory of nutritional status in India is necessary to develop appropriate policy responses that address the persistent and chronic problem of underweight and the emerging problem of overweight.

We acknowledge the support of Macro International Inc (Washington, DC) for providing access to the 2005–2006 Indian National Family Health Survey 3 data.

The authors’ responsibilities were as follows—SVS: conceived the study, contributed to the analysis, interpreted the results, and wrote the manuscript; JMP: led the analysis and contributed to the writing of the manuscript; and KTK contributed to the data analysis and the writing of the manuscript. All authors reviewed and approved the final version of the manuscript submitted for publication. None of the authors reported a conflict of interest.

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