Interpretations and Implications of Increasing Obesity in India
Data on Women from National Health Surveys

Sourindra Mohan Ghosh, Imrana Qadeer

The National Family Health Survey-3 and 4 data show that in the past 10 years, overweight/obesity among women in terms of Body Mass Index has increased quite sharply. In the Indian context, undernutrition and obesity are not separate problems. A large proportion of overweight/obese women are undernourished, with small stature, food transition towards more fats and increasingly sedentary lifestyles making them vulnerable towards being overweight/obese. More diversified diet reduces the risk of overweight/obesity. It is suggested that adequate and good quality diversified diets need to be ensured for comprehensive energy and nutrient adequacy. This requires an overhaul of India’s food programmes.

Increasing overweight and obesity in India has been under the scanner since the turn of the century. With the current levels of rising average relative weight, that is the Body Mass Index (BMI), global health experts concerned with the economic impact of non-communicable diseases (NCDs) in developing countries see the rising levels of obesity as a risk factor (Bloom et al 2014). The experts of NCDs such as diabetes, cardiovascular diseases and strokes in India see obesity “as the first wave of a defined cluster of non-communicable diseases called ‘New World Syndrome’ creating an enormous socioeconomic and public health burden in poorer countries” (Kalra and Unnikrishnan 2012: 37). Others argue that it is imperative for India to tackle the “modifiable risk factors” of overweight and obesity for NCD prevention and control (Khandelwal and Reddy 2013). This failure to perceive obesity as a part of the cluster of NCDs with shared roots, and its projection as an independent “modifiable risk factor” requiring direct interventions underlies the thrust of the current strategy to control NCDs through a biomedical approach to obesity. However, high levels of overweight/obesity coexisting with high levels of undernutrition are still being called the “double burden” of malnutrition.

Obesity is related to fat content in the body. There are different forms of obesity. Increased intra-abdominal/visceral fat (central or apple-shaped obesity) promotes a high risk of metabolic diseases. On the other hand, increased subcutaneous fat in the thighs and hips (peripheral or pear-shaped obesity) exerts “little or no risk” (Gesta et al 2007). The Indian population was said to be more of the former type (WHO 2000). For the lack of adequate population data, BMI is used as a proxy measure of relative body fat content, which increases the risk of NCDs. A BMI of 25 or above is termed as overweight, and that of 30 or above is termed as obesity. The objective was to identify populations at high risk of NCDs.

The lowering of diagnostic BMI criteria for overweight and obesity in tune with World Health Organization’s (WHO 2004) proposition was accepted by many. The integrated National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS), with its special cell working at different levels, emphasised early diagnosis and management within health services, making it in effect a vertical strategy. The concern about the absence of attention to obesity in India’s National Nutrition Policy (1993) is expressed in

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proposals of revisiting the policy with a view to suggest action against junk foods, television viewing guidelines and advertisements, control of street foods, food safety standards, labelling and packaging. In addition to these measures, surveillance of risk factors and interventions into modifiable risk factors through health campaigns, higher intake of fruits and vegetables, and increasing their production is suggested (Khandelwal and Reddy 2013). Some of these steps are required, but are far from offering a holistic policy. They also do not consider the declining public health infrastructure.

These policy suggestions while addressing the issues of quality and safety did not explore the relationship between intrauterine and early undernutrition, and obesity. The area specialists either saw the problem of obesity in isolation from undernutrition and only as a risk factor for NCDs. In other words, the clinical perspective of obesity and NCDs dominated their approach. While the logic of “continuum of risk” for NCDs (Khandelwal and Reddy 2013) was accepted to lower the BMI cut-offs to define overweight and obesity, a similar continuum of risks of obesity among undernourished and that of infections in the rising levels of both—undernutrition and obesity—was not explored.

Thus, it is worthwhile to review the way we understand obesity and its causes, classify and measure its prevalence, and its linkages with undernutrition. This will help rearticulate the problem in a context of continued intractable undernutrition at the population level and draw some preliminary suggestions for nutritional, agricultural and food security policies.

**Background and Existing Debates**

Obesity was not an issue in India when its impact on population health was being explored in developed countries. When it did become noticeable, it was treated as a new problem born out of India’s prosperity, and much attention was paid to it given the known associations with diabetes and cardiovascular diseases. It was said that India was going through another epidemiological transition from communicable to non-communicable diseases. A rising per capita gross domestic product (GDP), urbanisation and falling rates of severe and moderate undernutrition were taken as sufficient evidence of diseases of prosperity making their appearance.

**Probable causes:** Other than diseased states, overconsumption coupled with a sedentary lifestyle may be a cause for obesity. In India, the per capita daily calorie intake of the top quintile in cities was more than 2,500 kcal in 2004–05 and 2011–12, against an average requirement of 2,100 kcal (Qadeer et al 2016). On the other hand, 63% and 59% of the population in 2011–12 took diets insufficient in calories in urban and rural areas respectively (Qadeer et al 2016). In the context of increasingly sedentary lifestyles and occupations, overconsumption can very well be one of the contributors of increasing overweight/obesity among the richer sections, although probably not so much for the poor and middle classes.

Poor quality carbohydrate-based diets with reduced activity may also be a cause for obesity. It is not only the contribution of fat in the total energy intake that is important, but also the type of fat intake. Some induce insulin resistance increasing the risk of type-2 diabetes while others contain it (Brown et al 2010). Saturated fats are more prone to deposition as compared to poly/mono unsaturated fatty acids. Traditional oils (including palm olein) were considered better, which are probably on a decline with the availability of cheaper refined oils (Narasimhan et al 2016). Refined cereals with low roughage and high sugar content are also unhealthy. It is currently being argued that in India, we need to, “focus on a balance between fats, carbohydrates and proteins, rather than emphasise individual macronutrients” (Mani and Kurpad 2016). Pramil Singh et al (2014) emphasised the importance of whole plants in diets and underlined the fact that the absence of nuts and fruits from most ordinary Indian diets explains the vulnerability of the prevalent Indian vegetarianism to NCDs. An added dimension is the current policy emphasis on encouraging processed food industry at the cost of health and nutritional status (Jackson et al 2014).

The influence of undernutrition on intrauterine and early childhood development is also identified as a factor for metabolic pathway alterations leading to later-life overweight/obesity. Causality of overweight/obesity and its linkages with historically persistent maternal undernutrition and early childhood negative nutritional environment (Mani and Kurpad 2016) are the currently explored explanations within “the developmental origins of health and disease (DOHaD)” approach (Newnham 2007). These explanations were inspired by the Dutch famine cohort study—which followed up individuals in different phases of growth—on the effect of intrauterine nutritional deprivation. It was found that intrauterine nutritional deprivation led to metabolic adaptation, which may involve growth stunting outcomes (Barker 1997).

**Types of obesity:** Ideally, definitions of overweight and obesity should be based on the percentage of body fat. But, to generate population data requires expensive technology. Hence, for practical purposes, BMI is the epidemiological tool to assess overweight and obesity in populations. This weight-for-height index has a high correlation with adiposity, but it does not quantify adiposity or inform about body fat distribution. At times, BMIs are inappropriately used as the diagnostic criterion for labelling individuals rather than using them as a guidance for population assessment at a point and over time (Hubbard 2000). Well-built people may have a BMI that identifies them as overweight even though they do not have excess body fat, and those with BMIs in the normal range may have excess amount of body fat and be vulnerable to co-morbidities.

With a growing understanding of obesity, abdominal obesity, generalised obesity and combined obesity have been recognised as types with differing implications. Of these, the co-morbidities are significantly associated with abdominal and combined forms (Prasad et al 2011). Our understanding has further moved on from weight-height index (that is, BMI) measure of obesity to the category of “metabolically-obese,” the latter being identified in terms of insulin resistance,
glucose intolerance and altered fat metabolism. “Metabolically-obese” individuals can be non-obese by BMI, or the other way round, a metabolic healthy individual can be obese by BMI measure (Geetha et al. 2011).

The WHO expert consultation reviewing the BMI cut-off for Asia did recognise the variability of BMI-body fat correlation, body fat distribution (abdominal obesity) and low BMI across populations in Asia (WHO 2004). But, it was not explored why, within comparable across populations in Asia (Green et al. 2011). Why, within comparable BMI, is obesity more pronounced in urban areas and less in rural areas. In fact, in rural areas, the proportion of overweight has increased from 2.7% to 5.1% during the same time period. These figures offered explanations to analyse the differences of body composition (relatively lower skeletal muscle mass proportion and higher fat and not genetic makeup) of the Indian population compared to the Australians through their comparative study.

Kurpad et al. (2011) proposed that migration, poor environment, lifestyles borne out of living in poverty, led to a thin phenotype. Instead, “of greater concern to the expert consultation ... was whether the higher percentage of body fat at lower BMI also reflects increased risk of disease (diabetes and heart disease), risk factors for chronic disease, and death at lower BMI in Asian populations” (WHO 2004: 160) rather than exploring the reasons of higher percentage of body fat at lower BMI among Asians. Possible explanations could be found from origins of obesity, or intrauterine and early childhood undernutrition (that we have discussed before) making adults vulnerable to obesity.

It is, therefore, important to recognise that while increasing levels of overweight and obesity may be contributing to the expansion of populations vulnerable to NCDs in some sections as studies show (Deepa et al. 2009; Geetha et al. 2011), mere identification of higher-risk populations is not enough. We need to get to the root of this expanding vulnerability. Therefore, our objective in this article is to explore the links between undernutrition and malnutrition and the conditions that contribute to overweight/obesity. We make use of the National Family Health Survey-3 and 4 (NFHS) data focusing on the age group of 15–49 years to look at the Indian reality and redefine the problem.

Shifts in Obesity

Henceforth, “underweight,” “normal,” “overweight” and “obese” or “obesity” is referred to in terms of BMI, unless mentioned otherwise. We have used the WHO international standards for our article. In the past 10 years, the NFHS data shows that India has witnessed an increase in the proportion of women who are overweight or obese. Figure 1 shows that overall, the percentage of overweight women increased from 9.7% in 2005–06 to 15.4% in 2015–16, and the percentage of obese women increased from 2.7% to 5.1% during the same time period. These figures are more pronounced in urban areas and less in rural areas. In fact, in urban areas, the proportion of overweight has tipped over the proportion of underweight in 2015–16.

Table 1: Increase in Overweight and Obesity Rates (%) between 2005–06 and 2015–16, and the Role of Age Shift

<table>
<thead>
<tr>
<th>Urban</th>
<th>Rural</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall difference (non-standardised)—percentage points</td>
<td>4.86</td>
<td>5.80</td>
</tr>
<tr>
<td>Overweight</td>
<td>3.07</td>
<td>1.90</td>
</tr>
<tr>
<td>Obese</td>
<td>1.07</td>
<td>0.49</td>
</tr>
<tr>
<td>Difference due to age shift—percentage points</td>
<td>0.58</td>
<td>0.14</td>
</tr>
<tr>
<td>Overweight</td>
<td>22</td>
<td>8</td>
</tr>
<tr>
<td>Obese</td>
<td>19</td>
<td>8</td>
</tr>
</tbody>
</table>

Thus, it is overweight that has increased more, compared to the increase in obesity. Eliminating the effect of ageing, obesity has increased by 2.1 percentage points overall, while overweight has increased by 5 percentage points in 10 years from 2005–06 to 2015–16. While overweight and obesity are increasing, a significant section of women are still underweight, although the percentage has reduced from 2005–06 levels. In 2015–16, 22.4% of the population was underweight, while 20.5% population was overweight and obese.

This increase in overweight/obesity is surprising because the decades of 1990s and the 2000s till 2009–10 have seen a gradually increasing proportion of people being calorie deficient. Even after some reduction of calorie deficiency in 2011–12, 63% and 59% of people in rural and urban areas respectively, were still calorie deficient (Qadeer et al. 2016). Thus, it is important to look into the exact nature of overweight/obesity and the possible effects of dietary shifts.

Possible Contributors

The increasing trend of overweight/obesity relates to the pattern of food consumption and employment shifts over time. Food intake data for 2015–16 is not available. Instead, we use...
overweight/obesity figures from 2012–13 and compare it with the latest available 2011–12 average daily per-consumer unit food intake data from the National Sample Survey (nss). The baseline would be the 2005–06 overweight/obesity data which will be triangulated with the nss 2004–05 food intake data. We have used state-level data for 20 states (that is, except the smaller north-eastern states, barring Assam). The percentages of women who are overweight/obese have been calculated from the unit data of NFHS-3 for 2005–06, District Level House hold and Facility Survey (DLHS-4) and Annual Health Survey (AHS), 2012–13 for 2012–13, at the state level. Observing per consumer unit intake (rather than per capita) allows us to negate the effects of changes in population’s age–sex composition. Figure 2 clearly shows that the states with higher per consumer fat intake have higher percentages of overweight/obese women; hence, the intake of fat (excess of which is stored in our body) is positively associated with overweight/obesity. In any case, protein and carbohydrate intake in India is not increasing and hence cannot have contributed to an increase in overweight/obesity. Figure 3 shows that states with higher increase in fat intake experienced higher increase in percent overweight/obese population.

Another factor contributing to obesity is occupational structure; the states with higher percentage of service-sector employment have higher percentage of overweight/obesity (Figure 4).

Such a dietary shift towards more fats, but not necessarily an increase in overall volume of food intake (Ghosh and Qadeer 2017), coupled with sedentary lifestyles increases the risk of overweight/obesity. It indicates that the occupational shifts in India from physically active to relatively sedentary work have not created enough leisure time or incentives to encourage desirable levels of discretionary recreational physical activity/exercises (as advised by FAO [2004]). This phenomenon is more prevalent in urban areas, causing greater incidence of overweight/obesity as we have seen earlier.

Class Location

The proportion of underweight women has gone down in the past 10 years, and this decline has been relatively higher in the poorer populations. However, even among the top two richest wealth quintiles, 16.8% and 11.4% women are still underweight in 2015–16. Obesity is concentrated more in the wealthier sections compared to overweight. Almost 74% of obese women are in the top two quintiles; on the other hand, a significant proportion of overweight women (38%) come from the bottom three quintiles.

Figure 5 shows that in the two top wealth quintiles, 20.7% and 25.1% of women are overweight in addition to 7.3% and 10.9% being obese (in 2015–16). The “normal” category (18.5≤BMI<25) has expanded for the bottom three quintiles, between 2005–06 and 2015–16, but not for the top two quintiles. It also seems that a shift of population from normal to overweight/obese categories is starting from the second-poorest quintile onwards in 2015–16. In poorer quintiles, this shift from normal category is primarily to overweight category
rather than obese; a significant percentage of 9.4% and 14.8% women in the second-poorest and middle wealth quintiles, respectively, are overweight although only a small proportion are obese.

Physical and Nutritional Characteristics

Table 2 shows that the average height of women is quite low (around 152 cm) and does not vary of much across BMI groups. The heights of more than one-third of women is 1.5 m or shorter, and this is true for even those individuals who are in the overweight or obese category. Around 93%–94% women across all BMI groups have a less than ideal height of 1.61 m by Indian Council of Medical Research (ICMR) standards. The average body weight of the normal group is below 50 kg, while that of the underweight category is not even 40 kg. More than 80% of women of the normal group are below the ideal 55 kg. More than 90% of women in the overweight category are above 65 kg; around 67% of them weigh 65 kg or less. These women who are severely undernourished.

Table 2: Physical Characteristics of Women by BMI Status

<table>
<thead>
<tr>
<th>BMI Groups</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
<th>Height &lt; 1.61 m</th>
<th>Weight &lt; 65 kg</th>
<th>Up to 1.5 m</th>
<th>Less than 55 kg</th>
<th>Less than 12 g/dl</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005–06 (NFHS-3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>151.8</td>
<td>39</td>
<td>11.31</td>
<td>100.0</td>
<td>100.0</td>
<td>38.8</td>
<td>93.4</td>
</tr>
<tr>
<td>Normal</td>
<td>151.8</td>
<td>48</td>
<td>11.51</td>
<td>86.7</td>
<td>99.6</td>
<td>38.6</td>
<td>94.1</td>
</tr>
<tr>
<td>Overweight</td>
<td>152.4</td>
<td>63</td>
<td>12.01</td>
<td>7.8</td>
<td>67.0</td>
<td>33.5</td>
<td>93.2</td>
</tr>
<tr>
<td>Obese</td>
<td>152.3</td>
<td>77</td>
<td>12.03</td>
<td>0.3</td>
<td>5.9</td>
<td>33.5</td>
<td>93.5</td>
</tr>
<tr>
<td>Total</td>
<td>151.9</td>
<td>47</td>
<td>11.50</td>
<td>81.4</td>
<td>94.1</td>
<td>38.0</td>
<td>93.7</td>
</tr>
<tr>
<td>2015–16 (NFHS-4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>151.8</td>
<td>39</td>
<td>11.43</td>
<td>99.9</td>
<td>100.0</td>
<td>39.1</td>
<td>93.4</td>
</tr>
<tr>
<td>Normal</td>
<td>151.9</td>
<td>49</td>
<td>11.63</td>
<td>82.9</td>
<td>99.5</td>
<td>37.9</td>
<td>94.1</td>
</tr>
<tr>
<td>Overweight</td>
<td>152.3</td>
<td>63</td>
<td>11.87</td>
<td>7.6</td>
<td>66.7</td>
<td>34.3</td>
<td>93.3</td>
</tr>
<tr>
<td>Obese</td>
<td>151.9</td>
<td>76</td>
<td>11.90</td>
<td>2.6</td>
<td>8.4</td>
<td>36.0</td>
<td>93.1</td>
</tr>
<tr>
<td>Total</td>
<td>151.9</td>
<td>51</td>
<td>11.64</td>
<td>71.0</td>
<td>89.9</td>
<td>37.5</td>
<td>93.8</td>
</tr>
</tbody>
</table>

* Nagaland is excluded from NFHS-4 for haemoglobin/anaemia estimates to make it strictly comparable with NFHS-3, although we checked that the results do not vary even if this adjustment is not made.

For the overweight category of women, the average body weight is 63 kg; around 67% of them weigh 65 kg or less. These are the women (65 kg or below) who are actually not extremely heavy in terms of body weight, in the sense that they would not have shown up as overweight/obese in terms of BMI had they achieved a healthy stature/height. Unsurprisingly, in 2015–16, 47% of women in the overweight category are anaemic, up from 43.7% in 2005–06, reflecting that a majority of them are also undernourished.

The average weight of women categorised as obese is 76 kg and more than 90% of them weigh over 65 kg. In 2015–16, 46.8% of them are anaemic, up from 43.5% in 2005–06. This category mostly represents women who are truly heavy in terms of body weight along with high prevalence of anaemia indicating current malnutrition. About 36% of them have a height of 1.5 m or less, pointing towards probable childhood/adolescent undernutrition.

Increasing BMI shows a positive association with certain NCDs, some more than the other. For example, diabetes shows a steep increase in overweight and obese population (although, not so much for the relatively younger age group) compared to heart disease (Figure 6). The latter, on the other hand, show a much weaker increase with rising BMI.

The biggest challenge in drawing such inferences in population data is to earmark an “ideal” group with which NCD risks of the others can be compared. Many women in the...
“normal” BMI group are undernourished and can hardly be deemed as our “ideal” comparator group. It means that even if their risk of NCDs is relatively lower, they have a different disease profile altogether with much higher risk for diseases of poverty (Prüss-Üstün and Corvalán 2006; Katona and Katona-Apte 2008).

Apart from susceptibility to communicable diseases, food deprivation—a major problem for India—has other associations such as hypotension (low blood pressure [BP])8. This is something that has not been studied adequately in India although its causes are known to be diseases, drugs and deficiencies of salt, water, and nutrients. Increasing hypertension (high blood pressure) is linked with overweight and obesity, but hypertension is more widespread. Figure 8 shows that 58% of overweight and obesity is linked with overweight and obesity, and this of the underlying nutritional deficiencies even in these categories. Figure 8 shows that 35% heart patients have hypotension compared to 18% having hypertension, and even in the normal BMI category, almost 43% have hypotension. What is more ironical is the fact that the prevalence of hypotension (28%) is higher than hypertension (17.6%) in the overweight category, while both are almost equally prevalent in the obese category (Figure 7). This high prevalence of low BP is indicative of the underlying nutritional deficiencies even in these BMI categories. Figure 8 shows that 35% heart patients have hypotension compared to 18% having hypertension, and this should not be ignored as it increases the risk of fatality in patients with coronary heart disease, just like hypertension (Vidal-Petiot et al. 2016).

**Diet: Reducing Risk of Overweight/Obesity?**

Women who are shorter than the ideal healthy height are especially at risk of being overweight/obese (in terms of BMI) without being too heavy in terms of body weight; today, they comprise a large proportion of total overweight/obese women in India. A good quality balanced diet is particularly important for them to maintain a healthy body weight. We will test the hypothesis whether balanced and quality diet reduces the risk of overweight/obesity for women who have relatively shorter stature.

**Model and data:** We construct a range from the ICMR, 2010 standard of healthy height (1.61 m) and weight (55 kg). We consider that a height less than 1.55 m can be safely termed as relatively short, and anyone weighing 60 kg and above be termed as relatively heavy in terms of body weight. Our study group is those women with height less than 1.55 m, but who weigh 60 kg or above (which would make them overweight/obese in terms of BMI); we term them as “low-height heavy-weight” (LHHW). Our comparator (or control) group are those with height less than 1.55 m and weight less than 60 kg, but, at the same time, are not overweight in terms of BMI.

The data source is the unit record data of NFHS-4. For all women, the NFHS records food consumption frequency of seven food items, such as pulses/beans, milk/curd, dark-green leafy vegetables, eggs, meat, fish and fruits. The frequency of consumption is recorded either as “daily,” “weekly,” “occasionally,” or “never;” these are assigned scores of 3, 2, 1, and 0, respectively. The scores of all seven food items (st) are then added up for individual woman denoting her level of food intake. This conforms to the studies that have shown that simple frequency (or their sums) of food consumption has positive correspondence with calorie and other nutrient intake (Ogle et al 2001; Hatløy et al 1998).

We have also constructed a food diversity indicator, which is the sum of the squares of shares of the scores of seven food items in her food intake. The methodology to construct food diversity variable is taken from Galha et al. (2012); the higher its value, more concentrated the diet is, and lower value means more diversified diet. Mathematically,

\[
\text{Food Intake} = \sum_{j=1}^{7} SF_j
\]

\[
\text{Food Diversity} = \sum_{j=1}^{7} \left( \frac{SF_j}{\sum_{j=1}^{7} SF_j} \right)^2
\]

Let us assume that probability of LHHW (\(P_{LHHW}\)) for an individual is dependent on her level of food intake (\(\text{food} \)), food diversity (FD), class (CL), caste (CT), age (AGE) and level of education (EDU). We define the relationship as follows:

\[
\ln \left( \frac{P_{LHHW}}{1 - P_{LHHW}} \right) = \beta_0 + \beta_1 \text{FOOD} + \beta_2 \text{FD} + \beta_3 \text{CL} + \beta_4 \text{CT} + \beta_5 \text{EDU} + \beta_6 \text{AGE} + \beta_7 \text{AGE}^2 + \beta_8 \text{URBAN} + \beta_9 \text{STATE}
\]

Given the level of food intake, a more diversified diet most probably means a better quality and balanced diet (that is, due
to more food sources, mix of nutrients is better ensured); particularly in our case where the seven food items include a mix of high-value/nutrient-rich vegetarian and non-vegetarian items. \( CI_j, CT_l \) and \( EDU_k \) are class (wealth quintiles), caste and level of education dummies \((i, j \text{ and } k \text{ number of dummies, respectively})\). Along with continuous variable \( AGE\), we have introduced its squared term \( (AGE^2)\) to observe if there is any differential effect of age. We have used an urban-dummy \( (\text{URBAN})\), with rural taking the value 0 and urban as 1. \( \text{STATE}^n \) are \( n \)-number of state dummies, to control for unobserved state level variations.\(^9\)

**Results:** The summary statistics of the independent variables are presented in Table 4. Compared to our control group, a greater proportion of \( \text{LHHW} \) women (that is, our study group) come from wealthier households and less from Scheduled Caste \( (\text{sc}) \) or Scheduled Tribe \( (\text{st}) \) households. Compared to our control group, less proportion of the \( \text{LHHW} \) women are uneducated, while a greater proportion of them go beyond primary education and enter the secondary-education level. The \( \text{LHHW} \) women are more from the urban sector compared to the non-\( \text{LHHW} \) women of the control group. The \( \text{LHHW} \) women have higher food intakes, but with the same level of food diversity even though they come from relatively more privileged socio-economic backgrounds.

<table>
<thead>
<tr>
<th>Food intake</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>0.317</td>
<td>0.465</td>
<td>0.552</td>
<td>0.497</td>
</tr>
<tr>
<td>Rural</td>
<td>0.068</td>
<td>0.252</td>
<td>0.073</td>
<td>0.260</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No education</td>
<td>0.308</td>
<td>0.462</td>
<td>0.221</td>
<td>0.415</td>
</tr>
<tr>
<td>Incomplete primary</td>
<td>0.065</td>
<td>0.247</td>
<td>0.063</td>
<td>0.242</td>
</tr>
<tr>
<td>Complete primary</td>
<td>0.068</td>
<td>0.252</td>
<td>0.073</td>
<td>0.260</td>
</tr>
<tr>
<td>Incomplete secondary</td>
<td>0.371</td>
<td>0.483</td>
<td>0.406</td>
<td>0.491</td>
</tr>
<tr>
<td>Complete secondary</td>
<td>0.080</td>
<td>0.271</td>
<td>0.089</td>
<td>0.285</td>
</tr>
<tr>
<td>Higher</td>
<td>0.108</td>
<td>0.310</td>
<td>0.149</td>
<td>0.356</td>
</tr>
<tr>
<td>Urban</td>
<td>0.317</td>
<td>0.465</td>
<td>0.552</td>
<td>0.497</td>
</tr>
</tbody>
</table>

The results of logistic regression (Table 5) show that higher food intake significantly increases the risk of \( \text{LHHW} \). Higher the value of food diversity variable, that is, the more concentrated a diet is, significantly higher is the risk of \( \text{LHHW} \). It is to be noted that we have controlled for level of food intake; so even at the same level of food intake, a more diversified diet still reduces the risk of \( \text{LHHW} \).

The relatively more “privileged” in terms of socio-economic background (wealth-class, caste) have higher risk of \( \text{LHHW} \), which is an expected result. The group of urban women, compared to their rural counterpart, are more likely to be \( \text{LHHW} \). Women with no education are least likely to be \( \text{LHHW} \), which increases gradually as her level of education improves. More sedentary lifestyles/work-type associated with increasing level of education might be a reason for this. However, from “complete secondary” level of schooling onwards, her risk of \( \text{LHHW} \) starts to reduce again. Her health consciousness increases with her level of education and perhaps improves her awareness regarding types of food or physical activity and helps her limit the negative impact of sedentary lifestyles/work-type. As age increases, the risk of \( \text{LHHW} \) also increases, but at a decreasing rate. All these results are statistically significant.

**Discussion:** Two issues have become amply clear. First, the “normal” \( \text{BMI} \) category is not at all ideal for the Indian women at the population level. This puts into perspective the true magnitude of the problem of undernutrition, which remains confounded if \( \text{BMI} \) is seen as a stand-alone parameter.

Second, there are different metabolic pathways and hence different kinds of overweights and obesities. Undernourishment can be one of the pathways. In India, 50% of total overweight/obese women in \( \text{BMI} \) terms are not heavy in terms of body weight and suffer from undernutrition (extremely low height and high prevalence of anaemia). It reflects some form of undernourishment. Our results show that women with low...
height need good quality diversified diet to reduce their risk of overweight/obesity. So, while overweight/obesity can be a practical clinical screening parameter for NCDs, prevention of overweight/obesity that are rooted in undernutrition will not be possible without tackling the persisting problem of lack of adequate quality food for the poor.

The only way to ensure this is guaranteeing household food security (both quality and quantity) given the disadvantage of intra-household disparity of food distribution for women. Lowering Recommended Dietary Allowances as was done by the Narasinga and Sivakumar (2010) or trying out lower BMI cut-off points as “public health action point” (WHO 2004) would not prevent the problem of overweight/obesity.

A set of cohort studies from India have been attempting to follow up newborn babies till they are young adults and study the implications of low or high weights at birth and in early childhood for later life. Both are associated with increased insulin resistance as well as obesity during adulthood (Bhargava et al 2004; Sachdev et al 2005). The underlying processes of adiposity (higher body fat in thin infants), higher probability of infections, insulin resistance and micronutrient imbalance through epigenetic programming in early maternal and foetal undernutrition leading to obesity, diabetes and heart diseases have also been reported (Yajnik 2004). The cohort studies from Pune reflect on the role of maternal under and over nutrition arguing that

Both, maternal-foetal undernutrition and overnutrition are associated with increased adiposity and insulin resistance in the children ... Improving nutritional status of the young generation (especially that of young women in reproductive age) offers a potential for intergenerational prevention of NCDs. (Yajnik 2016)

This series points towards the implications of generational undernutrition in populations and notes that relative faster physical development (both height and weight) during infancy is strongly associated with adult lean mass.

This is not to refute that the problem of plenty or overconsumption does not exist in India. Those who are overweight/obese even with a “healthy” height of 1.61 m (or above) probably belong to that category. But, they account for only 1.33% of the women in 2015–16 (data not shown). There are overall only 6.2% women with height 1.61 m or above (Table 2). In India, the mean height of 18-year-old women increased by 5 cm from 147 cm in 1914 to 152 cm in 2014 and that of men by only 3 cm from 161 cm to 164 cm (NCD Risk Factor Collaboration 2016). In other developed regions, the maximum gains in height were 16 cm and 20 cm for men and women. Height is one of the important indicators of nutrition. Its “cross-population differences are believed to be related to non-genetic, environmental factors. Of these, foetal growth (itself related to maternal size, nutrition and environmental exposures), and nutrition and infections during childhood and adolescence are particularly important determinants of height during adulthood” (NCD Risk Factor Collaboration 2016: 1). The vicious cycle of maternal deprivation, intrauterine growth retardation, small for date babies and, stunting, detains children from attaining their growth potential and they end up as adults with high BMIs. BMI as an indicator does not reveal India’s policy failures in achieving optimum population heights and weights.

The WHO’s logic for lowering BMI cut-off for overweight and obesity (for the Asian population) was that it “would increase their prevalence rates overnight and, therefore, increase governmental and public awareness” (WHO 2004: 161) to identify higher numbers of people with NCD risk. However, this would not contribute to understanding genesis of overweight/obesity and its prevention. There is no simple “fit-for-all” solution to the growing problem of overweight/obesity. In the Indian context, attention is needed towards food policy as much of the population at risk is present among nutritionally vulnerable groups. Childhood and adolescent nutrition and nutrition of young women of reproductive age are extremely important; they should get adequate quantity of food with enough variety so that requirements of energy and different nutrients are met adequately. Adults who have low height (and have attained maximal height), aggravate the risk of overweight/obesity by increasing quantity of food intake, but they can reduce their risk through good quality diversified diets as our findings indicate.

Conclusions
The “double burden of malnutrition,” which is largely perceived as a combination of two separate problems—undernutrition and obesity—is not really so in the Indian context. The latter, which is perceived as a new epidemic of transitional societies with its associated NCDs over and above widespread undernutrition, is actually rooted in the former to a large extent. To break this link between the two, India needs a comprehensive strategy for health and food security. The long-standing strategy of cheap carbohydrate-based food to meet calorie adequacy (which was no doubt crucial) must evolve to ensuring energy and nutrient adequacy (calorie, protein and micronutrients). Ensuring food sufficiency of that sort has to go hand in hand with measures to increase awareness regarding overweight/obesity, its associated risk with NCDs, and the role of diets. There is an urgent need for a comprehensive nutrition policy. The existing food programmes need strengthening and overhaul. It is time that the public distribution system includes pulses, vegetables and coarse-cereals and not just wheat and rice. Anganwadi and school meals should include variety like eggs and milk, and the district healthcare infrastructure with its community health, primary health and sub-health centres must be equipped with necessary resources to tackle all malnutrition-related morbidities.
Notes

1 Measured as body weight (kg) per height squared (square meter).
2 Underweight (BMI<18.5), Normal (18.5< BMI<25), Overweight (25< BMI<30), Obese (BMI>30).
3 Per consumer unit is calculated by taking into account age and sex of individuals. Taking the calorie requirement of an average male in the age group 20–39 as the standard (that is, one consumer unit), the average calorie requirements of males and females of other age groups are expressed as a ratio of this. This is averaged at the household level; individual intake data for women is not available in NSS. For more details, see MoSPI (2014: 8).

The smaller states in North East India were excluded keeping in mind the general concern about quality of data in national level surveys. We have, however, checked that including the North East states, that is, total of 27 states, does not alter our results.

The Expert Group of the Indian council of Medical Research (Narasinga and Sivakumar 2010) had categorised the 95th percentile height of rural Indian women—1.61 m—as the reference/standard height of a healthy Indian woman.

The Expert Group of ICMR (Narasinga and Sivakumar 2010) considered body weight of 55 kg as the benchmark for healthy women.

Which is the 95 percentile height for rural women (1.62 m in NFHS-4); achieving this “healthy” height, a 65 kg woman would yield a BMI of 24.8—the ceiling for non-overweight.

Normal BP is just the converse of high BP.

“Healthy” height, a 65 kg woman would yield a BMI of 24.8—the ceiling for non-overweight.

We have, however, checked that including the North East states, that is, total of 27 states, does not alter our results.


REFERENCE


