Descriptive epidemiology of body mass index of an urban adult population in western India

H C Shukla, P C Gupta, H C Mehta, J R Hebert

METHODS

The anthropometric data presented in this report were obtained from a baseline cross sectional survey conducted between 1991 and 1994 for a cohort study on tobacco attributable mortality. The survey was carried out in the main city of Mumbai. A sampling frame was constructed from the electoral rolls. The sampling unit was a “polling station”, consisting of 1000–1500 eligible voters. Rolls were assumed to be complete, as they are updated before every major election through house to house visits. Electoral rolls were organised by geographical areas. The selection of polling stations was done in a non-random manner to exclude those with apartments having high security as it became evident during the pilot study that it would not be possible to gain access to such apartments. Investigators approached all people aged ≥35 years (cut off chosen because of the overall goal of studying tobacco attributable mortality in the cohort) listed in the selected polling stations for interview and anthropometric measurements. People not present on the voters’ list also were interviewed.

Abbreviations: BMI, body mass index; CED, chronic energy deficiency
and included in the sample if their residence status was confirmed by their having a ‘ration card’. These cards, issued by the Bombay Municipal Corporation, act as a proxy for residence cards and permit access to all city and state government services (including receiving certain food items at subsidised prices). Such people comprised about 5% of the sample. Less than 1% of people approached did not agree to be surveyed. The study satisfied all criteria of ethical treatment of human subjects; especially women, were recruited and surveyed. The study satisfied all interviewers and provide anthropometric measurements. A sample. Less than 1% of people approached did not agree to be subsidised prices. Such people comprised about 5% of the

Multivariable analysis was performed using logistic regression. The response variable, BMI, was converted into a dichotomous variable by using two cut off points: 18.5 and 25.0 kg/m² for analysis of thinness and 18.5–25 and 25–30 kg/m² were used for analysis for predictors of overweight. Three possible models corresponding to these two cut off points were fit. Age (in five year age groups), education, and tobacco use were fit as independent variables in the final model.

RESULTS

Table 1 shows the mean age specific anthropometric values for men and women. Men were 13 cm taller and 7 kg heavier

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Adjusted odds ratio (OR) for thinness by level of education and tobacco use*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td>Women</td>
</tr>
<tr>
<td>Education status</td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>4.83 (3.71 to 6.28)</td>
</tr>
<tr>
<td>Primary</td>
<td>2.25 (1.73 to 2.93)</td>
</tr>
<tr>
<td>Middle</td>
<td>4.92 (3.18 to 7.80)</td>
</tr>
<tr>
<td>Secondary</td>
<td>1.78 (1.33 to 2.38)</td>
</tr>
<tr>
<td>College</td>
<td>1.00</td>
</tr>
<tr>
<td>Tobacco use</td>
<td></td>
</tr>
<tr>
<td>No tobacco use</td>
<td>1.00</td>
</tr>
<tr>
<td>Smokes</td>
<td>2.26 (1.24 to 3.38)</td>
</tr>
<tr>
<td>Smoking</td>
<td>2.89 (1.77 to 4.72)</td>
</tr>
<tr>
<td>Mixed</td>
<td>3.12 (1.80 to 5.41)</td>
</tr>
</tbody>
</table>

*Results are controlled for age and other tobacco use (for the educational status results) or educational status (for the tobacco use results). †All ORs were significant at p < 0.0001.
Table 4 Adjusted odds ratio (OR) for overweight by level of education and tobacco use*

<table>
<thead>
<tr>
<th>Educational status</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illiterate</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Primary</td>
<td>1.35 [1.21 to 1.49]</td>
<td>1.44 [1.38 to 1.52]</td>
</tr>
<tr>
<td>Middle</td>
<td>1.57 [1.41 to 1.75]</td>
<td>1.47 [1.38 to 1.57]</td>
</tr>
<tr>
<td>Secondary</td>
<td>1.59 [1.40 to 1.80]</td>
<td>1.47 [1.33 to 1.63]</td>
</tr>
<tr>
<td>College</td>
<td>2.25 [2.00 to 2.58]</td>
<td>1.90 [1.64 to 2.20]</td>
</tr>
<tr>
<td>Tobacco use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No tobacco use</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Smoker</td>
<td>0.82 [0.77 to 0.88]</td>
<td>0.72 [0.69 to 0.76]</td>
</tr>
<tr>
<td>Smoking</td>
<td>0.77 [0.70 to 0.84]</td>
<td>0.59 [0.58 to 0.92]</td>
</tr>
<tr>
<td>Mixed</td>
<td>0.72 [0.66 to 0.80]</td>
<td>0.77 [0.45 to 1.32]</td>
</tr>
</tbody>
</table>

*Results are controlled for age and either tobacco use (for the educational status results) or educational status (for the tobacco use results). †All ORs were significant at p<0.0001 except the one marked.

DISCUSSION

The Mumbai population was on average, 12 cm shorter, 24 kg lighter, and had a BMI 2.2 kg/m² higher compared with the most elderly (85+ years). The youngest women were, on average, 8.1 cm taller, 11.8 kg heavier, and had a BMI 3.2 kg/m² higher compared with the eldest women.

In men, prevalence of thinness and overweight were similar (19.5% and 19.2% respectively) (table 2). By contrast, in women, there was a significantly higher prevalence of overweight (29.7%) compared with thinness (19.1%). The prevalence of severe thinness (BMI <16 kg/m²) was similar in both men and women (4.8% and 5.7%, respectively). More women were obese (BMI >30 kg/m²) compared with men (6.8% vs. 2.2%) and 0.2% of women had a BMI >40 kg/m². In both men and women, the older cohorts (75+ years) had higher prevalence of thinness while obesity was highest in the 45–54 years old cohort. Table 3 and 4 give the odds ratio for thinness and obesity associated with levels of education (adjusted for age and tobacco use) and for tobacco use (adjusted for age and level of education).

Key points

- Urban India faces the public health burden associated with both the extremes of malnutrition—that is, thinness and overweight.
- The “at risk” groups for thinness are illiterate/less educated and elderly while the college educated middle age groups are “at risk” of overweight.
- Tobacco use including oral use (a common practice in India) is an independent risk for thinness in this population.
- There is a need to integrate education and health policy for interventions to alleviate thinness and curb overweight.

thinness has not been reported thus far except in one urban slum population, which reported that 36.7% were underweight and 11.6% were overweight. The BMI profile presented in this paper is from the largest urban survey done on adults in India to date. Besides being one of the largest cities in India, Mumbai is the country’s financial centre and is host to people from all states of India. The age distribution of the study sample was similar to that of urban India. Literacy in the sample study was 87.6% and 54.7% compared with 81.3% and 62.5% for urban India for men and women, respectively (15–59 age group). We excluded affluent housing residents and adults aged 20–34 years of age. While this might be seen as a limitation, it can be argued that middle to low income strata form a substantial segment of the population and are the groups in whom the epidemiological transition will have the most impact. The findings presented in this paper provide evidence that both overweight and thinness are equally prevalent in the urban population of Mumbai.

Emerging problems related to overweight against a background of chronic underweight in large segments of the population raises important questions about policies aimed at health promotion. For example, in a country with a preponderance of overweight a recommendation can be targeted at lowering BMI values without much concern for thinness (except among people with eating disorders). On the other hand, in a country with a preponderance of thinness, a recommendation can be targeted at increasing body weight without much concern for inducing obesity or overweight related illness. In this study, we have found that it will be necessary to attend to both overweight and overweight portions of the distribution in identifying vulnerable targeting interventions. Because age, education, and tobacco use are independently associated with BMI, such targeting will need to take these factors into account.

Age and BMI

Age seems to be an independent risk factor for thinness. In interpreting this association, it must be noted that in cross sectional surveys the observed associations between age and BMI most probably reflect both the secular and the longitudinal changes in the physical status. Despite this, a high prevalence of thinness among the aged is of concern. This is in contrast with observations in elderly populations in affluent countries such as the UK, where 5% of men and 6% of women aged 75+ years are thin, and 64% men and 57% women are overweight. There may be many reasons for higher prevalence of thinness among elderly Indians. Because of “cohort” effects, older people may have been thinner throughout their life span. Also, in the older age groups, mortality and morbidity may influence the anthropometric profile with thinness being associated with longevity. To some extent, thinness can be seen as an adaptation consonant with long term survival. On the other hand, loss of income and independence may have caused a drop in the BMI in the elderly group. It is most likely that a combination of all these factors influences BMI in the
early 70s. Economic status and overweight existed in the UK in the 1950s to economic class and BMI, a positive association between socioeconomic transition. For example, although in the UK association is not static but changes over time and with the epidemiological transition. For example, in the USA, obesity is twice as high in men with < a 9th grade education (26.6%) compared with graduates (10.0%).

Education level and BMI were positively associated only in men from Moscow and Poland. By contrast, in women, 22 of 26 countries showed an inverse relation between education and BMI. An inverse association is the norm in many affluent countries, most notably the US. Clearly, the education-BMI association is not static but changes over time and with the epidemiological transition. For example, although in the UK there currently exists an inverse relation between socioeconomic class and BMI, a positive association between socioeconomic status and overweight existed in the UK in the 1950s to early 70s. One explanation for this “inversion” in the association between educational level and BMI is the relation between occupation and education. In countries in transition, where less educated people are in labour intensive occupations and people with higher education are living a more sedentary lifestyle, a positive association between education and BMI will be seen, as in this study. In economically advanced countries, lower education may be associated with higher unemployment or low paid jobs that are not necessarily labour intensive. Leisure time physical activity may be the major determinant of BMI. Increased health awareness and access to recreational facilities among the highly educated (affluent) groups compared with the less educated would result in an inverse relation between education and BMI. For example, in the USA, obesity is twice as high in men with < a 9th grade education (21.7%) compared with college graduates (11%) and two and half times higher in women with < a 9th grade education (26.6%) compared with graduates (10.0%).

Female college graduates in Mumbai have a similar prevalence of obesity (11.1%) as Americans; however, illiterate Indian women have a lower prevalence of obesity (5.1%) and a higher prevalence of thinness (24.3%). Indian men have a very low prevalence of obesity overall. However, prevalence was highest (3.6%) in graduate men.

Tobacco use and BMI
In our study all forms of tobacco use were independently associated with lower BMI. Lower BMI in smokers compared with non-smokers has been reported in many studies. The smoking-BMI association has been attributed to the effect of smoking on physiological processes that lead to changes in appetite, food preferences, and basal metabolic rate. There have been no previous reports on smokeless tobacco use and, as far as we are aware, this is the first to show smokeless tobacco use as an independent risk for low BMI. This merits further investigation as tobacco use in India takes a variety of smokeless and smoking forms, of which cigarettes are only a minor part.

Conclusions
This study showed that both chronic underweight and overweight are equally present in an urban population of India, with important public health implications for the burden of diseases associated with both extremes of physical status. Moreover, findings relating age, education, and tobacco use to BMI provide information for further study and formulation of health policy. High prevalence of thinness in the less educated urban populations coupled with a high prevalence of overweight among the more educated is a matter of great concern. The World Bank estimates that malnutrition costs India at least US$10 billion annually in terms of lost productivity, illness, and death. If the present trend of rural to urban migration continues, less educated agricultural male labourers are the most likely to migrate because industrialisation and the diminishing contribution of agriculture to GDP may force them to seek alternative sources of income in urban areas. The size of the less educated urban population is a key determinant of the prevalence of thinness. Therefore, the burden of diseases associated with thinness will most probably continue to be a major public health challenge in urban India. As migration continues, the transition from low to higher education occurs in the middle class and those aspiring to middle class status. Thus, the burden of overweight associated diseases also will continue to increase. To meet this double burden of public health challenges, policy makers may need to consider the formulation of an integrated health and education policy that aims to improve educational status and alleviate illiteracy related thinness yet curb the increase of obesity in urban India.

The other vulnerable group at risk of thinness is the elderly. This segment of the population is growing worldwide and concern for the nutritional status of the elderly has been expressed in many countries. The BMI distribution observed in the elderly in this urban survey provides evidence that provisions for the care of this group need to be considered carefully by health care policy makers. Further studies on other determinants of adult BMI and on the distribution of BMI in children and young adults in urban India are urgently required to obtain a fuller picture of high risk populations for both extremes of BMI.

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Conflicts of interest: none
REFERENCES


31. Registrar General of India. Literacy rate by important age groups and sex. 1991 Census data online at URL: http://www.censusindia.net


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