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Social factors and overweight: evidence from nine Asian INDEPTH Network sites

Abdur Razzaque[1]*, Lutfun Nahar[2], Hoang Van Minh[3], Nawi Ng[4], Sanjay Juvekar[5], Ali Ashraf[6], Syed Masud Ahmed[7], Kusol Soonthornthada[8], Uraiwan Kanungsukkasem[8] and Tran Huu Bich[9]

[1]Matlab Health and Demographic Survillance System, Bangladesh; [2]East West University, Dhaka; [3]Filabavi Health and Demographic Surveillance System, Vietnam; [4]Purworejo Health and Demographic Surveillance System, Indonesia; [5]Vadu Health and Demographic Surveillance System, India; [6]AMK Health and Demographic Surveillance System, Bangladesh; [7]WATCH Health and Demographic Surveillance System, Bangladesh; [8]Kanchanaburi Health and Demographic Surveillance System, Thailand; [9]Chililab Health and Demographic Surveillance System, Vietnam

Background: Overweight/obesity increases the risk of morbidity and mortality from a number of chronic conditions, including heart disease, stroke, diabetes and some cancers. This study examined the distribution of body mass index (BMI) in nine Health and Demographic Surveillance System (HDSS) sites in five Asian countries and investigated the association between social factors and overweight.

Data and methods: This cross-sectional study was conducted in nine HDSS sites in Bangladesh, India, Indonesia, Thailand and Vietnam. The methodology of the WHO STEPwise approach to Surveillance with core risk factors (Step 1) and physical measurements for weight, height and waist circumference (Step 2) were included. In each site, about 2,000 men and women aged 25–64 years were selected randomly using the HDSS database. Weight was measured using electronic scales, height was measured by portable stadiometers and waist circumference was measured by measuring tape. Overweight/obesity was assessed by BMI defined as the weight in kilograms divided by the square of the height in metres (kg/m^2).

Results: At least 10% people were overweight (BMI $\geq$25) in each site except for the two sites in Vietnam and WATCH HDSS in Bangladesh where few men and women were overweight. After controlling for all the variables in the model, overweight increases with age initially and then declines, with increasing education, and with gender with women being heavier than men. People who eat vegetables and fruits below the recommended level and those who do high level of physical activity are, on the whole, less heavy than those who eat more and do less physical activity.

Conclusions: As the proportion of the population classified as being overweight is likely to increase in most sites and overweight varies by age, sex, and social and behavioural factors, behavioural interventions (physical exercise, healthy diet) should be developed for the whole population together with attention to policy around nutrition and the environment, in order to reduce the adverse effects of overweight on health.

Keywords: *obesity*; *overweight*; *body mass index*; *risk factor surveillance*; *WHO STEPS*; *Asia*

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Overweight/obesity increases the risk of morbidity and/or mortality from a number of chronic conditions including diabetes, heart disease, stroke, raised blood pressure and some cancers (1). Body mass index (BMI) is a strong predictor of overall mortality both above and below the optimum of about 22.5–25 kg/m^2. The excess mortality above the range is due to mortality in vascular diseases and is probably largely causal. The excess mortality below 22.5 kg/m^2 is due mainly to smoking-related diseases, and is not fully explained (2).

Overweight/obesity has reached epidemic level in high-income countries and its prevalence is also increasing in low and middle-income countries (3). The rising

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overweight/obesity epidemic in recent decades reflects the profound changes in society and in behavioural patterns of people. Biological factors cannot fully explain human obesity without considering psychological, social, cultural and environmental influences (4). Thus, societal changes and worldwide nutrition transition are driving the overweight/obesity epidemic. There is also evidence that undernourishment in early life is an additional risk factor for obesity and other chronic diseases in later life (5).

Studies suggest that obesity is socially distributed, with certain social groups at increased risk. Substantial evidence demonstrates an inverse relation between social class and body weight and the risk of obesity among women and less consistently among men in wealthy countries (6, 7), whereas the relationship is direct in the low and middle-income countries (6). Although evidence is somewhat less consistent, marital status has been linked cross-sectionally with obesity (8) and longitudinally with weight gain (9).

Studies of the relationship between social factors and overweight/obesity are limited in the low and middle-income countries. However, this study used the framework of Sobal (10) and examined the role of health habits in explaining the relation between social factors and overweight/obesity; this model suggests that differences in eating, physical and other weight-related activities account for differences in overweight/obesity across social groups.

Data and methods

Taking advantage of the existing Health and Demographic Surveillance System (HDSS) sampling frame, a representative sample of about 1,000 men and 1,000 women of adults aged 25–64 years from each site was randomly selected using the WHO STEPS methodology (11). Data were collected using a personal household interview conducted by trained field workers. Similar instruments were used across sites to collect the data: weight was measured to the nearest 10 g using electronic scales while height was measured to the nearest 0.1 cm using portable stadiometers. The basic methodology has been described elsewhere (12). Briefly, weight and height were measured without shoes and wearing light clothes. Waist circumferences were measured using non-elastic tape to the nearest 0.1 cm. Waist circumference was measured at the midpoint between the lower margin of the last rib and the top of the hip bone at the end of expiration, with the measuring tape put at umbilicus level.

Overweight/obesity was assessed by using BMI defined as the weight in kilograms divided by the square of the height in metres (kg/m^2). The BMI is used to assess overweight and obesity as it has a strong correlation to body fat content. According to the WHO criteria, overweight is defined if BMI is ≥ 25 kg/m^2 and a person is considered obese if the BMI is ≥ 30 kg/m^2 (1). However, work is in progress in WHO using different cut points for overweight/obesity for Asia-Pacific region. Although the data are yet to be validated, there is some suggestion that a more appropriate cut point for overweight and obesity in these populations would be 23.0–24.9 kg/m^2 and ≥ 25.0 kg/m^2, respectively (13).

Level of education was assessed on the highest level of education completed. In this analysis, education was categorised into four groups (no schooling/not graduated from primary, graduated from primary, graduated from secondary and graduated from high school/ university).

As part of the core items, standardised information was gathered on fruit and vegetable consumption (12, 14). Those who ate less than five servings of fruits and/or vegetables on average per day were defined as those who did not meet the recommended level; two categories, below level and above level were used in the analyses.

The physical activity was measured using the Global Physical Activity Questionnaire Version 2 (GPAQ2) (12, 15, 16). The respondents were asked to detail time spent on each vigorous and moderate activities related to work, travel and recreational activities. The number of days spent on vigorous and moderate activities and total physical activity Metabolic Equivalent (MET) minutes per week were used to classify respondents into three categories of low, moderate and high level of physical activity (15).

Both bivariate and multivariate analyses were performed. For multivariate, logistic regression was performed to predict overweight for social as well as behavioural factors. To test whether full-model (age, sex, education, fruit/vegetable consumption and physical activity) or sub-model (age, sex and education) predict overweight better, –2 loglikelihood values were compared for the difference.

Results

Fig. 1 shows distribution of BMI by site and sex. The proportion of people who were underweight (BMI ≤ 18.5) was between 25 and 35% for both men and women in most sites; the notable exception was in Kanchanaburi where it was less than 10%. Conversely in Kanchanaburi, one in four men and almost one in two women (44%) were overweight (BMI ≥ 25). The sites with the lowest proportion of the people who were overweight were in Vietnam. Women were heavier on the whole than men, especially in Purworejo (24.3% vs 9.5%) and Kanchanaburi (44.3% vs 23.9%). Obesity (BMI ≥ 30) was relatively uncommon in these populations with the notable exception of Kanchanaburi where 4% of men and 12% of women were obese (Table 1).

The mean BMI varied between 19.5 and 21.5 for both men and women while mean waist circumference varied

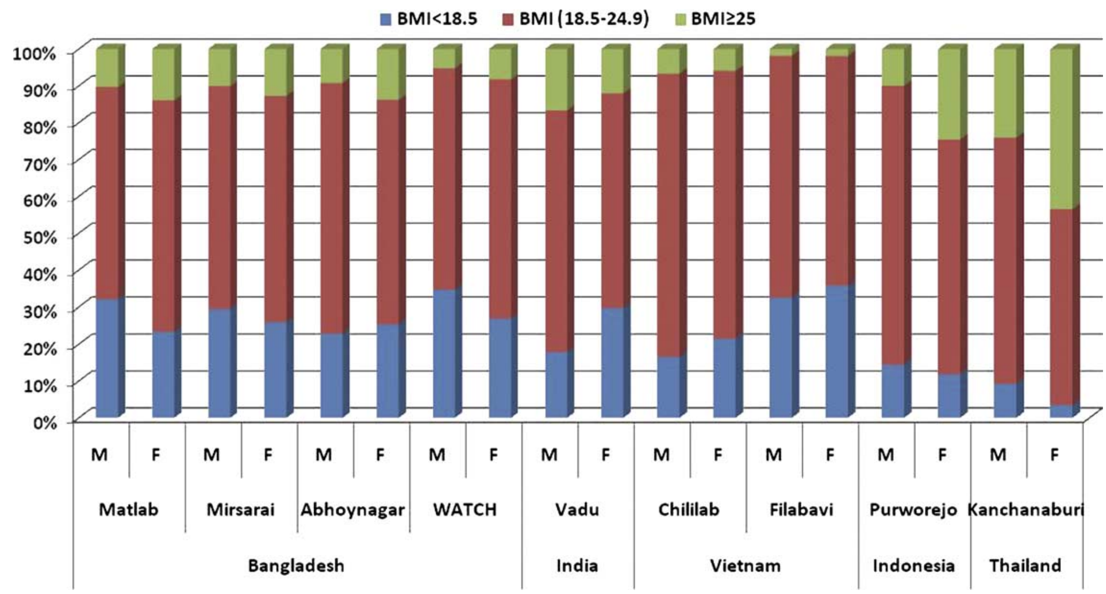

Fig. 1. Distribution of body mass index by sites and sex.

between 72 and 80 cm except for Kanchanaburi (Table 1). The mean BMI was higher for women than men while mean waist circumference was higher for men than women.

Overweight varied by age among male and took U-shape except for Matlab, while among female it also varied by age and took inverted U-shape except for Vadu and Chililab (results not shown). Waist circumference varied by age among male and it took inverted U-shape except for WATCH, while among female it took inverted U-shape except for Vadu, Chillilab and Kanchanaburi (results not shown).

Two models were tested: a full-model (age, sex, education, fruit/vegetable consumption and physical activity) and a sub-model (age, sex and education). The full-model differed significantly from sub-models for each site (last two rows of Table 2 show –2 loglikelihood of full and sub-models).

After controlling for all the variables in the model, being overweight increased with age, except in Filabavi. Women were generally heavier than men. Being overweight was positively related to education except for Filabavi and Kanchanaburi. The likelihood of overweight increased for those who consumed vegetables/fruits above the recommended level and for those who did less physical activity compared to those who ate less and did high level of physical activity, respectively.

Discussions

This paper highlights a surprising burden of overweight in rural populations in Asian INDEPTH sites. The cross-site study uses data from nine HDSS sites in five Asian countries with diverse socio-economic and cultural backgrounds. Although the data collected from the sites followed the same methodology and the Principal

Table 1. Percent obese (BMI ≥30), mean body mass index and mean waist circumference (cm), by site and sex

	Bangladesh				India	Vietnam		Indonesia	Thailand
Variables	Matlab	Mirsarai	Abhoynagar	WATCH	Vadu	Chililab	Filabavi	Purworejo	Kanchanaburi
Men									
BMI ≥30 (%)	1.1	0.6	0.9	0.4	1.6	0.3	0.1	0.9	4.2
Mean BMI (cm)	20.4	20.4	20.8	19.7	21.6	20.8	19.5	21.1	22.7
Mean waist circumference (cm)	76.9	77.1	75.1	73.8	80.8	75.9	71.5	73.3	81.7
Women									
BMI ≥30 (%)	1.8	2.3	1.6	0.8	2.3	0.3	0.3	4.0	12.1
Mean BMI (cm)	20.9	21.0	21.1	20.2	20.9	20.7	19.5	22.5	24.8
Mean waist circumference (cm)	77.1	74.0	70.9	70.4	71.2	72.6	68.9	74.8	82.6

Table 2. Logistic regression model of odd ratios (95% CI) of factors associated with overweight in nine HDSS sites

	Bangladesh				India	Vietnam		Indonesia	Thailand
Characteristics	Matlab	Mirsarai	Abhoynagar	WATCH	Vadu	Chililab	Filabavi	Purworejo	Kanchanaburi
Age									
25–34	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
35–44	1.54 (1.05–2.28)	2.05 (1.34–3.13)	2.18 (1.42–3.37)	1.65 (1.00–2.72)	1.82 (1.25–2.66)	2.14 (1.11–4.11)	1.35 (0.43–4.22)	1.57 (1.09–2.26)	1.26 (0.95–1.67)
45–54	1.38 (0.92–2.06)	2.20 (1.42–3.40)	2.27 (1.46–3.53)	1.13 (0.66–1.94)	1.99 (1.34–2.95)	4.09 (2.23–7.49)	2.64 (0.93–7.48)	1.96 (1.35–2.85)	1.86 (1.40–2.47)
55–64	0.92 (0.58–1.44)	1.60 (1.01–2.53)	1.93 (1.22–3.04)	0.96 (0.54–1.71)	2.39 (1.56–3.67)	3.75 (2.01–7.02)	2.08 (0.70–6.20)	1.23 (0.82–1.86)	1.40 (1.05–1.86)
Sex									
Female	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Male	0.55 (0.40–0.77)	0.56 (0.40–0.79)	0.44 (0.31–0.60)	0.44 (0.29–0.67)	1.05 (0.80–1.36)	1.03 (0.73–1.47)	0.78 (0.40–1.52)	0.31 (0.24–0.42)	0.38 (0.31–0.46)
Level of education									
No schooling/not graduated from primary	0.17 (0.11–0.27)	0.20 (0.12–0.33)	0.23 (0.13–0.41)	0.25 (0.13–0.45)	0.41 (0.28–0.59)	0.52 (0.27–0.99)	0.58 (0.16–2.01)	0.45 (0.30–0.69)	0.81 (0.57–1.16)
Graduated from primary	0.40 (0.28–0.61)	0.43 (0.24–0.76)	0.40 (0.20–0.78)	0.41 (0.20–0.83)	0.47 (0.29–0.75)	0.50 (0.28–0.89)	0.24 (0.05–1.15)	0.49 (0.34–0.70)	0.94 (0.68–1.31)
Graduated from secondary	0.59 (0.33–1.07)	0.41 (0.25–0.66)	0.69 (0.40–1.20)	0.70 (0.34–1.40)	0.63 (0.43–0.92)	0.42 (0.28–0.63)	0.80 (0.36–1.79)	0.67 (0.45–1.01)	1.15 0.74–1.79
Graduated from high school/ university	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Diet – WHO recommended									
Below	0.75 (0.49–1.15)	0.69 (0.36–1.34)	0.50 (0.30–0.63)		0.25 (0.15–4.13)	0.82 (0.57–1.16)	0.38 (0.18–0.81)	0.79 (0.53–1.18)	0.89 (0.71–1.10)
Above	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00
Physical activity									
Low	1.80 (0.98–2.60)	1.42 (0.99–2.04)	1.58 (1.13–2.22)	1.05 (0.65–1.71)	1.25 (0.88–1.77)	1.30 (0.80–2.13)	1.91 (0.85–4.28)	1.44 (1.07–1.95)	1.09 (0.85–1.38)
Medium	1.79 (1.09–2.95)	1.68 (1.12–2.52)	1.40 (0.97–2.01)	1.64 (0.95–2.82)	0.87 (0.58–1.29)	1.30 (0.85–1.98)	0.47 (0.05–3.84)	1.85 (1.16–2.95)	0.96 (0.77–1.21)
High	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
–2 Loglikelihood	1,332.1	1,349.3	1,327.2	894.6	1,645.7	1,021.8	353.3	1,605.2	2,608.0
df (full-model)	10	10	10	9	10	10	10	10	10
–2 Loglikelihood	1,339.3	1,357.7	1,340.8	897.7	1,652.9	1,025.3	363.5	1,616.7	2,609.8
df (sub-model)	7	7	7	7	7	7	7	7	7

Investigators went through a common training programme along with the use of common measurement instruments, it is possible that systematic error (intra site and worker) could affect the findings. The proportion of the population who are overweight is particularly high in Kanchanaburi; equally, the high proportion of people who are underweight in Filabavi, means that obesity has not yet obtained a foothold in these populations. These data are comparable with previous surveys in these countries (17).

Overweight increases with age initially and then declines at the highest age group. This is consistent with an increase in age for other biological risk factors such as blood pressure as well as behavioural factors such as tobacco use and physical inactivity. The probability of developing chronic NCDs increases with age (18) and there is also evidence that chronic NCDs occur at younger ages in poorer countries than in wealthier countries (3).

This study also suggests that overweight increases significantly with increases in education levels although there are two notable exceptions in Chililab and Purworejo. The overweight relationship found in this study is consistent with other studies in similar rural populations (6) but does not correspond with those in high-income countries (19, 20). In many low and middle-income countries, overweight and even obesity is viewed as a sign of health and wealth and can be associated with sexual attractiveness (21, 22). The high proportion of the population who are underweight is probably due to undernourishment and lack of access to adequate food along with a high energy expenditure associated with rural occupations (21). The pattern in Chililab and Purworejo among people with higher education could be due to an increase in awareness and capacity to take measures against overweight.

Similar to a previous study (23), our study found that after controlling for physical activity and fruit and vegetable consumption, education remained a significant predictor of overweight/obesity. Education was used as a proxy indicator of socio-economic status, but other components of socio-economic status, not included in our analyses, may be important in predicting overweight/obesity (19).

Overweight/obesity is uncommon among those who ate fruit/vegetable below the recommended level and who also reported a high level of physical activity compared to those who ate above the level and who undertook less physical activity. Use of fruit and vegetable intake as a proxy measure of diet, however, may not be sufficiently discriminating in this population (14). Eating less fruits and vegetables than the recommended level could result from a number of reasons including scarcity of food, while those who consumed fruits and vegetables above the recommended level, might do so because of purchasing power; they would also be more likely to eat more fish and meat. Involvement in high physical activity (except leisure) is also a reflection of low socio-economic status and high energy expenditure related to occupation.

As the proportion of overweight is likely to increase in most sites in the future and is associated with age, sex and social and behavioural factors, healthy lifestyle interventions, combined with health promoting policies and programmes should be developed for the whole population in order to reduce the adverse effects of overweight on health. It will be important to monitor changes in food consumption patterns as well as the patterns of weight in these populations over time. In the meantime, this baseline survey provides ample evidence of a potentially looming problem of diabetes and other chronic diseases in some of these sites in the absence of appropriate interventions.

Conflict of interest

The authors have declared no conflict of interest.

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***Abdur Razzaque**
Matlab Health and Demographic Surveillance System Bangladesh
Public Health Sciences Division, ICDDR, B
Centre for Health and Population Research
Mohakhali, Dhaka 1212, Bangladesh
Email: razzaque@icddrb.org