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Covariates of Overweight and Obesity Among Women in North India

Praween Agrawal and Vinod Mishra

Praween Agrawal is a Ph.D. student at the International Institute for Population Sciences in Mumbai.

Vinod Mishra is a Fellow in Population and Health Studies at the East-West Center in Honolulu.

Address correspondence to: Dr. Vinod Mishra, Population and Health Studies, East-West Center, 1601 East-West Road, Honolulu, HI 96848-1601, USA; Tel: (1-808) 944-7452; Fax: (1-808) 944-7490; Email: MishraV@EastWestCenter.org.

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Abstract

Objective. To study the covariates of overweight and obesity among adult women in north India and to examine the association between obesity and adverse pregnancy outcomes.

Methods. The analysis is based on 5273 ever-married women of reproductive age (15–49) in the states of Delhi and Punjab, included in India's second National Family Health Survey (NFHS-2), conducted in 1998–1999. Body mass index (BMI) was used to define overweight ($25 \leq BMI < 30$ kg/m^2) and obese (BMI$\geq$30.0 kg/m^2). Adverse pregnancy outcome was defined as a miscarriage or stillbirth. Covariates included in the study are age, urban/rural residence, education, husband's education, media habits, food habits, anemia status, work status, type of work, religion, caste/tribe, and household standard of living. Binary and multinomial logistic regression methods were used to estimate the effects of these covariates on overweight and obesity and effects of overweight and obesity on adverse pregnancy outcomes.

Results. The study finds that age, urban residence, media habits, anemia status, and economic living standard are most important covariates of overweight and obesity among women in India. A separate analysis by women's age finds that media habits and living standard are more important covariates for older women (30–49), whereas place of residence and education are more important covariates for younger women (15–29). The study also finds that overweight and obese women age 15–29 are significantly more likely to have experienced a miscarriage or

stillbirth (OR=1.57; 95%CI: 1.06, 2.33 for overweight and OR=2.10; 95%CI: 1.02, 4.29 for obesity). This relationship is not observed among older women.

Conclusion. Study identifies key covariates of overweight and obesity and suggests that overweight and obesity may increase the risk of adverse pregnancy outcomes. There is need for prospective epidemiological studies to better understand the causes and consequences of the growing obesity epidemic in India.

Introduction

Rapidly changing diets and lifestyles are fueling the global obesity epidemic (WHO, 2003).

According to recent estimates, there are more than one billion overweight people worldwide,

and some 300 million of these are estimated to be clinically obese (WHO, 2002). Once

considered a problem related to affluence, obesity is now fast growing in many developing

countries and in poor neighborhoods of the developed countries (WHO, 2003; WHO, IASO, &

IOTF, 2000). Even in countries like India, which are typically known for high prevalence of

undernutrition, significant proportions of overweight and obese now coexist with the

undernourished (Popkin, 2002).

Problems of overweight and obesity are caused by chronic imbalance between energy intake and

actual energy needs of the body. In many developing countries, with increasing urbanization,

mechanization of jobs and transportation, availability of processed and fast foods, and

dependence on television for leisure, people are fast adopting less physically active lifestyles

and consuming more "energy-dense, nutrient-poor" diets (WHO, 2003; Bell, Ge, & Popkin, 2002;

Popkin, 2002, 2001; Popkin, Horton, Kim, Mahal, & Shuigao, 2001; Drewnowski & Popkin, 1997).

As a result, overweight and obesity and associated chronic health problems, such as diabetes,

hypertension, cardiovascular disease, cancer, and muscluloskeletal disorders, are increasing

rapidly, particularly among the middle-class, urban populations (WHO, 2003; Popkin, 1998;

Tanaka & Nakanishi, 1996; Saw & Rajan, 1997).

Overweight and obesity are most closely related to non-insulin dependent diabetes mellitus

(NIDDM) or Type 2 diabetes (Ishikawa-Takata, Ohta, Moritaki, Gotou, & Inoue, 2002; Ko, Chan,

Cockram, & Woo, 1999; Seidell, 1997; McKeigue, Shah, & Marmot, 1991). It is estimated that more than two-thirds of all diabetes mellitus cases can be linked to overweight conditions (Seidell, 1997). Developing countries account for an increasing share of diabetes cases. More than half of the world's newly diagnosed cases of diabetes come from India and China (McLellan, 2002). Overweight and obesity have also been closely associated with ischaemic heart disease (Willett, Manson, Stampfer, Colditz, Rosner, Speizer, et al., 1995; Kannel, D'Agostino, & Cobb, 1996), hypertension (Stamler, Stamler, Riedlinger, Algera, & Roberts, 1978; Dyer & Elliott, 1989; Ishikawa-Takata et al., 2002; Ko et al., 1999), dyslipidaemia (Ishikawa-Takata et al., 2002; Despres, 1994; Ko et al., 1999), and cancer (Lew & Garfinkel, 1979; Shike, 1996). WHO estimates that approximately 58% of diabetes mellitius, 21% of ischaemic heart disease, and 8-42% of certain cancers can be attributed to BMI above 21 kg/m^2 (WHO, 2002).

Overweight conditions have been linked with gallstones and liver abnormalities (Stampfer, Maclure, Colditz, Manson, & Willett, 1992); low back pain (Deyo & Bass, 1989; Garzillo & Garzillo, 1994; Han, van Leer, Seidell, & Lean, 1995); osteoarthritis of the hands and wrist (Carman, Sowers, Hawthorne, & Weissfeld, 1994); reduced lung function, airways hyperresponsiveness, and asthma symptoms (Tantisira & Weiss, 2001; Gibson, 2000; Shaheen, 1999; Camargo, Weiss, Zhang, Willett, & Speizer, 1999; Mishra, 2003); and sleep apnea (Millman, Carlisle, McGarvey, Eveloff, & Levinson, 1995; Young, Palta, Dempsey, Skatrud, Weber, & Badr, 1993).

Obesity has also been associated with menstrual dysfunction (Douchi, Kuwahata, Yamamoto, Oki, Yamasaki, & Nagata, 2002; Lake, Power, & Cole, 1997; Hartz, Barboriak, Wong, Katayama, & Rimm, 1979); reproductive disorders including infertility (Pettigrew & Hamilton-Fairley, 1997;

Rich-Edwards, Goldman, Willett, Hunter, Stampfer, Colditz, et al., 1994; Zaadstra, Seidell, van Noord, te Velde, Habbema, Vrieswijk, et al., 1993; Hartz et al., 1979); increased abortion rates (Hamilton-Fairley, Kiddy, Watson, Peterson, & Franks, 1992); and pregnancy complications and adverse pregnancy outcomes (Lake et al., 1997; Kliegman & Gross, 1985).

WHO typically defines adult overweight as a body mass index (BMI)[1] of 25.0–29.9 kg/m^2; and adult obesity as a BMI $\geq$ 30.0 kg/m^2. However, it is observed that in Asian populations health risks associated with overweight and obesity occur at lower levels of BMI than in north America or Europe (Ko et al., 1999; Deurenberg-Yap, Yian, Kai, Deurenberg, & van Staveren, 1999), and it is now being suggested that lower cutoff points for BMI be used to categorize overweight and obese conditions for Asian populations (WHO, IASO, & IOTF, 2000). Moreover, there is greater realization that both the amount of body fat and its distribution are important in determining health risks associated with overweight conditions. In many Asian populations, abdominal or central obesity (measured by waist circumference or the ratio of waist to hip circumference) is found to be more common than obesity defined by BMI (McKeigue et al., 1991). A study in India observed that about 20% of adults who were not overweight or obese as per the BMI definition still had abdominal obesity (Gopalan, 1998).

In the past, governments in many developing countries with high levels of undernutrition and high prevalence of communicable diseases have paid little attention to the problems of overweight and obesity. Now with rapidly growing obesity epidemic and associated chronic diseases the situation is beginning to change. But, partly due to lack of data, understanding of causes and consequences of this rapidly growing public health threat remains poor.

Previous research on obesity in India has found the prevalence of obesity to be higher among women (Misra, Pandey, Devi, Sharma, Vikram, & Khanna, 2001; Zargar, Masoodi, Laway, Khan, Wani, Bashir, et al., 2000; Gopinath, Chadha, Jain, Shekhawat, & Tandon, 1994), and among economically better off persons (Griffiths & Bentley, 2001; Singh, Beegom, Verma, Haque, Singh, Mehta, et al., 2000; Dhurandhar & Kulkarni, 1992). Urban residence, family history of obesity, childbearing, and sedentary lifestyle have also been linked to obesity (Bhasin, Chaturvedi, Gupta, & Aggarwal, 2001; Griffiths & Bentley, 2001; Tiwari, Wagh, & Babar, 1998; Dhurandhar & Kulkarni, 1992). Several studies have related overweight conditions with diabetes, hypertension, and heart disease (Venkatramana & Reddy, 2002; Misra et al., 2001; Singh et al., 2000; Gopinath et al., 1994).

This study analyses data from a recent survey in India, which collected anthropometric data from a nationally representative sample of more than 90,000 ever-married women of reproductive age (IIPS & ORC Macro, 2000). The survey also collected data on a number of demographic and socioeconomic factors, as well as data on food habits, media habits, anemia status, and pregnancy outcomes. These data provide an opportunity to examine the covariates of overweight and obesity and its association with adverse pregnancy outcomes in India, which is undergoing rapid changes in lifestyles, physical activity patterns, and diets.

Data and Methods

Data. Data are from India's second National Family Health Survey (NFHS-2) conducted in 1998–99. NFHS-2 collected demographic, socioeconomic, and health information from a

nationally representative probability sample of 90,303 ever-married women age 15–49 residing

in 92,486 households. All states of India are represented in the sample (except the small Union

Territories), covering more than 99 percent of country's population. The sample is a multi-stage

cluster sample with an overall response rate of 98 percent. Details of sample design, including

sampling frame and sample implementation, are provided in the basic survey report for all India

(IIPS & ORC Macro, 2000). The analysis here focuses on ever-married women age 15–49 in

north Indian states of Delhi (n=2477) and Punjab (n=2796), with highest prevalence of

overweight and obesity in the country.

Response variables. In NFHS-2, each ever-married women age 15–49 was weighed using a solar-

powered scale with an accuracy of $\pm$ 100 g. Their height was measured using an adjustable

wooden measuring board, specifically designed to provide accurate measurements (to the

nearest 0.1 cm) in a developing-country field situation. The weight and height data were used to

calculate the body mass index (BMI)[2]. Women who were pregnant at the time of the survey or

women who had given birth during the two months preceding the survey are excluded. BMI can

be used to estimate the prevalence of underweight, as well as the prevalence of overweight and

obesity. A BMI of less than 18.5 kg/m^2 is defined as underweight, indicating chronic energy

deficiency. A BMI in the range of 18.5 and 24.9 kg/m^2 is defined as normal; 25.0 and 29.9 kg/m^2

as overweight; and more than 30.0 kg/m^2 as obese (WHO, 2003).

Based on these cut-offs, we created a four-category variable of nutritional status of women,

indicating underweight, normal BMI, overweight, and obese. In the analysis, we used different

formulations of this variable. When examining covariates of overweight and obesity, underweight women were excluded from the analysis.

The survey also asked each woman whether she ever experienced a miscarriage or stillbirth. We examine whether women's nutritional status (as defined by BMI) is correlated with the risk of an adverse pregnancy outcome.

Covariates. The survey collected information on a number of demographic and socioeconomic factors, as well as information on media habits and food habits, that could potentially affect the nutritional status of women and may confound the effect of nutritional status on pregnancy outcomes. The variables included in the analysis are: age (15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49); residence (urban, rural); education (illiterate, literate but less than middle school complete, middle school complete but less than high school complete, high school complete or higher)[3]; husband's education (illiterate, literate but less than middle school complete, middle school complete but less than high school complete, high school complete or higher); media habits—watches television every week (yes, no), reads newspaper or magazine every week (yes, no); food habits—milk or curd daily (yes, no), fruits daily (yes, no), green, leafy vegetables daily (yes, no), eggs at least weekly (yes, no), chicken, meat, or fish at least weekly (yes, no); anemia status (not anemic, mild anemia, moderate or severe anemia)[4]; work status (works at home, works outside, does not work); type of work (professional/technical, clerical/sales/service, laborer including agricultural work, household worker); religion (Hindu, Muslim, Sikh, other[5]); caste/tribe (scheduled caste/scheduled tribe[6], other backward class, other); and standard of living (low, medium, high)[7].

Analysis. We first examine inter-state differentials in the prevalence of overweight and obesity. Analysis of covariates of overweight and obesity is limited to the states of Delhi and Punjab. Covariates of overweight and obesity are analyzed using binary and multinomial logistic regression methods. Because of large age differentials in the prevalence of overweight and obesity and because the effects of covariates are likely to vary by age, the analysis is also carried out separately for women age 15–29 and 30–49. The analysis of effects of BMI (underweight, normal, overweight, obese) on the risk of adverse pregnancy outcomes (miscarriage or stillbirth) is carried out using logistic regression method, separately for women age 15–29 and 30–49. In multivariate models husband's education was not included because it is highly correlated with woman's education. Also, the type of work variable was not included due to small numbers of cases (85% of women in our sample do not work).

The logistic regression models are estimated using the STATA statistical software package (Stat Corporation, 2001). In the survey, certain states and certain categories of respondents were oversampled. In all our analysis, weights are used to restore the representativeness of the sample. The results are presented in the form of relative risks (RR) and odds ratios (OR), with 95% confidence intervals (95% CI). The estimation of confidence intervals takes into account design effects due to clustering at the level of the primary sampling unit.

Results

Prevalence of overweight and obesity. According to the NFHS-2, about 11% of ever-married women (15–49) in India are overweight or obese—8.4% overweight and 2.3% obese (Table 1).

The prevalence of overweight and obesity is highest in the northern states of Delhi and Punjab, where about one in three women are overweight or obese; followed by Goa and Kerala, where about one in five are overweight or obese. The prevalence of overweight and obesity is much lower in the economically less developed states of Uttar Pradesh, Madhya Pradesh, Rajasthan, Orissa, Assam, and Bihar (4–8%). Further analysis in this study has been restricted to the highest prevalence states of Delhi and Punjab.

<Table 1 about here>

In both Delhi and Punjab, prevalence of overweight and obesity increases rapidly with age. In Delhi, for example, proportion overweight rises from less than 10% at age 15–24 to about 40% at age 45–49. Correspondingly, proportion obese rises from less than 1% at age 15–24 to about 19% at age 45–49 (Table 2). Women living in urban areas are much more likely to be overweight and obese than those living in rural areas. Woman's education is strongly positively correlated with the levels of overweight and obese in both states. For example in Punjab, the proportion obese increases from less than 5% among illiterate women to more than 15% among those with high school or more education. A similar pattern is observed by husband's education.

<Table 2 about here>

Women who regularly watch television or read newspapers or magazines are much more likely to be overweight and obese in both Delhi and Punjab. For example in Punjab, women who watch television at least once a week are more than three-times as likely to be obese, and women who read newspapers or magazines at least once a week are more than two-times as likely to be obese as other women. Women who regularly consume high-calorie, high-fat foods such as milk, eggs, and meat tend to be more overweight and obese than other women. However, women who regularly consume fruits or green, leafy vegetables also tend to be more overweight and obese.

Obesity in Delhi does not seem to be correlated with consumption of green, leafy vegetables, eggs, and chicken, meat, or fish.

The likelihood of being overweight and obese is strongly negatively correlated with the anemia status of women, as expected. Women who are not anemic are about twice as likely to be overweight and obese as women with moderate to severe anemia in both Delhi and Punjab. Work status of women does not show any clear relationship with overweight or obesity, except in Punjab where women who work at home are more likely to be obese than those who do not work. However, the type of work is strongly correlated with overweight and obesity. Among workingwomen, those in professional or technical jobs are much more likely to be overweight or obese than other types of workers. Household workers are least likely to be overweight or obese. In Punjab, more than one-half of all women in professional, technical, clerical, sales, and service jobs are overweight or obese.

Prevalence of overweight and obesity among women is also correlated with religion and caste/tribe status. One out of every two Sikh women in Delhi is overweight or obese. By caste/tribe, women belonging to scheduled castes, scheduled tribes, and other backward class are considerably less likely to be overweight or obese than other women.

Economic living standard, measured by household ownership of consumer durables, is strongly positively correlated with the prevalence of overweight and obesity. For example in Punjab, proportion overweight rises from just 6% for women in low standard of living households to 26% for those in high standard of living households, and proportion obese rises from just 1% in low

standard of living households to 13% in high standard of living households. A similar pattern is observed in Delhi.

Covariates of overweight and obesity. Table 3 shows the estimated effects of selected demographic and socioeconomic covariates on the risk of being overweight and obese among ever-married women in north India (Delhi and Punjab combined). With other factors in the model controlled, relative risks of being overweight and obese increase rapidly with age. Women age 40–49 are more than 12 times as likely to be overweight or obese as women age 15–19. Urban residence also significantly increases the risk of obesity (RR=1.57; 95%CI: 1.06, 2.32), but not the risk of overweight (RR=1.16; 95%CI: 0.92, 1.47). Watching television every week has significant positive effect on the risk of overweight (RR=1.45; 95%CI: 1.09, 1.93) and reading newspaper or magazine every week has a significant positive effect on the risk of obesity (RR=1.50; 95%CI: 1.07, 2.10).

<Table 3 about here>

Effects of food habits on the risks of overweight and obesity are generally small and not significant statistically, except that eating fruits daily is associated with significantly increased risk of being obese. As expected, anemic women are significantly less likely to be overweight (RR=0.59; 95%CI: 0.43, 0.81) or obese (RR=0.53; 95%CI: 0.32, 0.86). Effects of religion and caste/tribe status on the risk of being overweight are small and not significant, but women belonging to a scheduled caste or scheduled tribe and those belonging to a religion other than Hindu, Muslim, or Sikh are significantly less likely to be obese than other women. As in the unadjusted case discussed in Table 2, household standard of living is strongly correlated with risks of being overweight and obese. Women in high standard of living households have a 3.8

times greater risk of being overweight (95%CI: 1.42, 10.00), and 3.6 times greater risk of being obese (95%CI: 0.46, 28.43). Large confidence intervals mainly reflect small numbers of cases in the sample. With various demographic and socioeconomic factors in the model controlled, women living in Punjab are significantly more likely to be obese than those living in Delhi (RR=1.78; 95%CI: 1.22, 2.60).

Table 4 presents estimated effects of selected covariates on the combined risk of being overweight or obese in the pooled sample for Delhi and Punjab. Separate models are estimated for 15–29, 30–49, and 15–49 age groups. For women age 15–49 (last three columns in Table 4), consistent with the results in Table 3, woman's age, urban residence, media habits, anemia status, and economic living standard have significant effects on the risk of being overweight or obese. In addition, scheduled caste and scheduled tribe women have significantly lower risk of overweight and obesity, and women living in Punjab have significantly higher risk of overweight and obesity.

<Table 4 about here>

Separate analysis by age shows that the covariates of overweight and obesity are quite different among younger women (15–29) than among older women (30–49). Among younger women, urban residence, education, and living in Punjab are more important covariates of overweight and obesity, whereas among older women, media habits, caste/tribe status, and economic standard of living are more important covariates. Anemia status is a significant covariate for both groups of women.

Effects of BMI on pregnancy outcomes. Table 5 presents the adjusted effects of women's nutritional status (underweight, normal, overweight, and obese) on the risk of adverse pregnancy outcomes (miscarriage or stillbirth) among women in Delhi and Punjab. Results suggest that overweight and obesity have strong effects on the likelihood of having experienced an adverse pregnancy outcome among younger women, but not among older women. After controlling for the socioeconomic factors, obese women age 15–29 are more than twice as likely to have experienced a miscarriage or stillbirth as those with a normal BMI (OR=2.10; 95%CI: 1.02, 4.29). On the contrary, among the older women age 30–49, underweight women are significantly more likely to have experienced an adverse pregnancy outcome (OR=1.37; 95%CI: 1.01, 1.87).

<Table 5 about here>

Among the control variables, higher living standard is associated with lower likelihood of adverse pregnancy outcomes among younger women and higher education is associated with higher likelihood of adverse pregnancy outcomes among older women. Older women are more likely to have experienced an adverse pregnancy outcome in more distant past, on average, than younger women and may not recall the experience as well as younger women. Moreover, among older women, more educated women may be more likely to recall an adverse pregnancy outcome. This may explain the lack of a relationship between overweight and obesity and adverse pregnancy outcomes among older women, and the evidence of a positive effect of education on the likelihood of adverse pregnancy outcomes.

Discussion

The study finds that considerable proportions of women in many parts of India are already overweight. The problem is particularly severe in the north Indian states of Delhi and Punjab, where about one in three women are overweight or obese. A multivariate analysis of covariates of overweight and obesity reveals that age, urban residence, media habits, anemia, and economic living standard are most important covariates of overweight and obesity in these states. A separate analysis by woman's age suggests that media habits and living standard are more important covariates for older women (30–49), whereas place of residence and education are more important covariates for younger women (15–29).

Results also suggest that overweight and obesity may increase the risk of adverse pregnancy outcomes. The study finds that overweight and obese women age 15–29 are significantly more likely to have experienced a miscarriage or stillbirth (OR=1.57; 95%CI: 1.06, 2.33 for overweight and OR=2.10; 95%CI: 1.02, 4.29 for obesity). This relationship is not observed among older women age 30–49.

There are a number of measurement concerns that should be kept in mind when considering the findings of this study.

First, our analysis is based on cross-sectional data, where prevalence of overweight and obesity is measured at the time of the survey and the experience of an adverse pregnancy outcome is from the past. A positive correlation between overweight and obesity and adverse pregnancy outcome can result if a woman became overweight or obese as a result of the pregnancy that

resulted in a miscarriage or stillbirth. Although, our analysis excludes pregnant women and those who gave birth in the preceding two months, possibility of such reverse causation cannot be ruled out.

Second, the survey only measured height and weight of the respondents. Other measures, such waist circumference or waist-hip ratio may better capture overweight and obesity conditions in India, especially as they relate to adverse health effects.

Third, the information on pregnancy outcomes is based on mother's recall and it is possible that some women, especially older women, may not recall an adverse pregnancy outcome in more distant past. Others may not report an adverse pregnancy outcome for cultural reasons. This may partly explain the lack of relationship between obesity and adverse pregnancy outcomes among older women in our analysis.

Fourth, the survey collected limited information on lifestyle, physical activity, and diet. Although, the demographic, socioeconomic, and lifestyle factors included in this study may capture much of the variation in lifestyle, physical activity, and diet, more detailed information on these subjects in future studies can help understand the causes of overweight and obesity better.

The results are useful in identifying population groups for public health campaigns to promote healthy diets and lifestyles to prevent the obesity epidemic and associated ill health and

mortality. To disentangle the effects of overweight and obesity on adverse pregnancy outcomes, carefully designed prospective epidemiological studies are needed.

Endnotes

[1] Defined as weight in kilograms divided by height in meters squared (kg/m^2).

[2] Survey did not collect data on indicators of fat distribution, such as waist circumference or waist-hip ratio, which are also important in determining obesity comorbidities.

[3] "Primary school complete" means 5–7 completed years of education, "middle school complete" means 8–9 completed years of education, "high school complete" means 10 or more completed years of education.

[4] Anemia in women is defined as a hemoglobin level of less than 11.0 g/dl for pregnant women and less than 12.0 g/dl for nonpregnant women.

[5] Other religions include Christian, Buddhist, Jain, Jewish, Zorastrian, and others.

[6] Scheduled castes and scheduled tribes are castes and tribes that the Government of India identifies as socially and economically backward and in need of special protection from social injustice and exploitation.

[7] Standard of living is defined as an index based on ownership of a number of different consumer durables and other household items. Standard of living is measured by an index calculated by adding the following scores: house type: 4 for *pucca*, 2 for semi-*pucca*, 0 for *kachha*; toilet facility: 4 for own flush toilet, 2 for public or shared flush toilet or own pit toilet, 1 for shared or public pit toilet, 0 for no facility; source of lighting: 2 for electricity, 1 for kerosene, gas or oil, 0 for other source of lighting; main fuel for cooking: 2 for electricity, liquefied natural gas, or biogas, 1 for coal, charcoal, or kerosene, 0 for other fuel; source of drinking water: 2 for pipe, hand pump, or well in residence/yard/plot, 1 for public tap, hand pump, or well, 0 for other water source; separate room for cooking: 1 for yes, 0 for no; ownership of house: 2 for yes, 0 for no; ownership of agricultural land: 4 for 5 acres or more, 3 for 2.0–4.9 acres, 2 for less than 2 acres or acreage not known, 0 for no agricultural land; ownership of irrigated land: 2 if household owns at least some irrigated land, 0 for no irrigated land; ownership of livestock: 2 if own livestock, 0 if not own livestock; durable goods ownership: 4 for a car or tractor, 3 each for a moped/scooter/motorcycle, telephone, refrigerator, or color television, 2 each for a bicycle, electric fan, radio/transistor, sewing machine, black and white television, water pump, bullock cart, or thresher, 1 each for a mattress, pressure cooker, chair, cot/bed, table, or clock/watch. Index scores range from 0–14 for low SLI to 15–24 for medium SLI to 25–67 for high SLI.

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subcontinent. *The Journal of the Association of Physicians of India 48* (12), 1170–1174.

Table 1. Percentage of overweight and obese women[a] (age 15-49) in India by state, 1998-99

State	Overweight $(25.0 \leq BMI < 30.0)$[b]	Obese $(BMI \geq 30.0)$	Overweight or obese $(BMI \geq 25.0)$
Delhi	24.7	9.3	34.0
Punjab	21.3	9.2	30.6
Goa	16.8	4.5	21.3
Kerala	17.0	3.9	20.9
Haryana	12.8	3.9	16.7
Gujarat	11.4	4.5	15.9
Sikkim	13.1	2.5	15.6
Tamil Nadu	12.1	2.7	14.7
Jammu	10.7	3.0	13.7
Karnataka	10.8	2.9	13.7
Himachal Pradesh	10.9	2.4	13.3
Andhra Pradesh	9.8	2.3	12.1
Maharashtra	9.0	2.9	11.9
Manipur	9.7	1.2	10.8
West Bengal	7.3	1.4	8.6
Nagaland	7.8	0.7	8.5
Tripura	6.7	1.7	8.4
Uttar Pradesh	5.9	1.6	7.5
Rajasthan	5.5	1.7	7.1
Madhya Pradesh	4.9	1.2	6.1
Meghalaya	4.7	1.3	5.9
Mizoram	4.8	0.5	5.3
ArunachalPradesh	4.6	0.6	5.2
Orissa	3.8	0.6	4.4
Assam	3.6	0.7	4.3
Bihar	3.2	0.5	3.7
India	8.4	2.3	10.6

a. Ever-married women. This table and all subsequent tables exclude women who were pregnant at the time of the survey and those with a birth in the two months preceding the survey.

b. The body mass index (BMI) is the ratio of the weight in kilograms to the square of the height in meters (kg/m^2).

Table 2. Percentage of overweight and obese women (age 15-49) in Delhi and Punjab by selected background characteristics, 1998-99

	Delhi		Punjab	
Characteristic	Overweight (25.0≤BMI<30.0)	Obese (BMI≥30.0)	Overweight (25.0≤BMI<30.0)	Obese (BMI≥30.0)
Age				
15-19	7.2	NC	1.3	1.7
20-24	9.9	0.7	11.6	0.9
25-29	17.7	5.1	16.8	5.5
30-34	26.3	9.5	18.1	10.2
35-39	29.7	12.5	27.9	13.3
40-44	30.5	13.0	28.7	12.4
45-49	39.5	18.9	30.9	14.5
Residence				
Urban	25.0	9.7	28.2	16.3
Rural	21.3	4.6	18.2	6.0
Education				
Illiterate	19.4	4.8	16.2	4.4
Literate, <middle complete	20.9	8.0	20.8	9.4
Middle complete	22.9	11.1	20.6	9.8
High school or more	29.9	12.3	29.0	15.3
Husband's education				
Illiterate	13.9	4.5	13.0	4.6
Literate, <middle complete	19.9	5.5	20.6	5.9
Middle complete	18.3	9.1	17.7	9.5
High school or more	28.4	10.8	27.3	13.0
Media habits				
Watches TV every week				
Yes	25.8	9.7	24.3	11.0
No	13.5	5.7	11.1	3.3
Reads newspaper/magazine every week				
Yes	28.6	12.7	28.6	16.4
No	20.7	5.9	18.0	6.0
Food habits				
Milk or curd daily				
Yes	27.5	10.5	23.0	9.9
No	20.5	7.5	14.7	6.5
Fruits daily				
Yes	28.3	15.9	31.3	17.6
No	23.3	6.7	19.2	7.4
Green, leafy vegetables daily				
Yes	26.6	9.3	22.4	10.0
No	22.1	9.4	18.4	7.0
Eggs at least weekly				
Yes	26.6	7.2	27.7	11.4
No	24.2	9.9	20.6	9.0
Chicken, meat, or fish at least weekly				
Yes	27.0	9.1	27.6	14.4
No	24.3	9.4	21.1	9.0
Anemia status				
Not anemic	27.0	10.7	23.6	10.9
Mild anemia	23.5	7.8	20.1	7.4
Moderate or severe anemia	13.4	5.0	13.7	5.3
Work status				
Works at home	21.4	6.8	27.3	18.7
Works outside	25.4	7.1	28.6	12.3
Does not work	24.8	9.9	20.6	8.7
Type of work				
Profession/technical	36.1	11.8	38.8	20.6
Clerical/sales/service	28.7	3.8	31.6	23.5
Laborer, including agricultural work	17.8	6.8	21.7	10.2
Household worker	11.4	3.8	13.7	4.2

Religion				
Hindu	24.6	9.0	21.3	11.3
Muslim	18.7	10.8	24.6	5.3
Sikh	37.8	13.7	21.0	8.0
Other	16.9	5.3	31.1	4.7
Caste/tribe				
SC/ST	18.3	3.3	14.9	3.5
OBC	15.6	4.9	20.3	7.9
Other	28.6	12.0	24.8	12.4
Standard of living				
Low	2.0	NC	5.9	1.1
Medium	14.8	4.8	14.2	4.2
High	29.6	11.5	26.4	12.7
Number of women	2,071		2,496	

NC: Not enough cases

Table 3. Adjusted effects (relative risks) of selected factors on the risk of being overweight (25.0≤BMI<30.0) or obese (BMI ≥ 30.0) among ever-married women age 15-49 in Delhi and Punjab, 1998-99

Characteristic	Overweight				Obese		
		95% CI				95% CI	
	RR	LL	UL		RR	LL	UL
Age							
15-19[†]	1.00	-	-		1.00	-	-
20-29	5.06	1.58	16.15		2.31	0.32	16.73
30-39	10.00	3.08	32.47		8.48	1.15	62.72
40-49	14.04	4.39	44.87		12.35	1.68	90.81
Residence							
Urban	1.16	0.92	1.47		1.57	1.06	2.32
Rural[†]	1.00	-	-		1.00	-	-
Education							
Illiterate[†]	1.00	-	-		1.00	-	-
Literate, <middle complete	0.96	0.75	1.23		1.28	0.81	2.03
Middle complete	0.98	0.72	1.34		1.46	0.88	2.41
High school or more	1.17	0.89	1.54		1.43	0.89	2.29
Media habits							
Watches TV every week	1.45	1.09	1.93		1.37	0.88	2.15
Reads newspaper/magazine every week	1.15	0.92	1.43		1.50	1.07	2.10
Food habits							
Milk or curd daily	1.06	0.88	1.27		0.85	0.64	1.13
Fruits daily	1.06	0.87	1.29		1.54	1.19	2.00
Green, leafy vegetables daily	1.16	0.98	1.37		1.01	0.79	1.28
Eggs at least weekly	1.21	0.96	1.54		0.75	0.50	1.14
Chicken, meat, or fish at least weekly	1.05	0.74	1.50		1.53	0.93	2.54
Anemia status							
Not anemic[†]	1.00	-	-		1.00	-	-
Mild anemia	0.90	0.74	1.09		0.75	0.58	0.96
Moderate or severe anemia	0.59	0.43	0.81		0.53	0.32	0.86
Work status							
Works at home	1.06	0.74	1.51		1.27	0.77	2.12
Works outside	0.99	0.77	1.28		0.70	0.46	1.07
Does not work[†]	1.00	-	-		1.00	-	-
Religion							
Hindu[†]	1.00	-	-		1.00	-	-
Muslim	1.02	0.73	1.44		1.09	0.52	2.30
Sikh	0.96	0.74	1.24		0.87	0.60	1.26
Other	0.83	0.44	1.60		0.42	0.18	0.99
Caste/tribe							
SC/ST	0.87	0.68	1.10		0.49	0.35	0.69
OBC	0.88	0.69	1.12		0.77	0.51	1.17
Other[†]	1.00	-	-		1.00	-	-
Standard of living							
Low[†]	1.00	-	-		1.00	-	-
Medium	2.49	0.92	6.75		2.47	0.31	19.46
High	3.77	1.42	10.00		3.61	0.46	28.43
State							
Delhi[†]	1.00	-	-		1.00	-	-
Punjab	1.12	0.88	1.41		1.78	1.22	2.60
Number of women				3,716			

[†] Reference category

LL: Lower Limit; UL: Upper Limit

Table 4. Adjusted effects (odds ratios) of selected factors on the risk of being overweight or obese (BMI ≥ 25.0) among ever-married women age 15-49 in Delhi and Punjab, 1998-99

Characteristic	15-29 OR	95% CI LL	95% CI UL	30-49 OR	95% CI LL	95% CI UL	15-49 OR	95% CI LL	95% CI UL
Age									
15-19[†]	NA	NA	NA	NA	NA	NA	1.00	-	-
20-29	NA	NA	NA	NA	NA	NA	4.14	1.49	11.45
30-39	NA	NA	NA	NA	NA	NA	9.51	3.40	26.59
40-49	NA	NA	NA	NA	NA	NA	13.49	4.95	36.77
Residence									
Urban	1.52	0.99	2.34	1.22	0.91	1.62	1.27	1.01	1.60
Rural[†]	1.00	-	-	1.00	-	-	1.00	-	-
Education									
Illiterate[†]	1.00	-	-	1.00	-	-	1.00	-	-
Literate, <middle complete	1.11	0.65	1.92	0.94	0.71	1.25	1.03	0.80	1.32
Middle complete	1.36	0.76	2.45	0.91	0.63	1.33	1.08	0.80	1.46
High school or more	1.77	1.05	3.00	0.97	0.71	1.33	1.22	0.95	1.58
Media habits									
Watches TV every week	1.00	0.58	1.71	1.54	1.17	2.03	1.43	1.10	1.86
Reads newspaper/magazine every week	1.10	0.74	1.63	1.36	1.05	1.76	1.24	1.01	1.52
Food habits									
Milk or curd daily	0.83	0.57	1.20	1.06	0.87	1.28	1.00	0.84	1.19
Fruits daily	1.03	0.76	1.40	1.28	1.02	1.61	1.18	0.98	1.42
Green, leafy vegetables daily	1.09	0.81	1.47	1.13	0.94	1.36	1.12	0.95	1.31
Eggs at least weekly	1.02	0.67	1.56	1.08	0.83	1.41	1.08	0.86	1.35
Chicken, meat, or fish at least weekly	1.07	0.58	1.97	1.18	0.81	1.72	1.15	0.83	1.59
Anemia status									
Not anemic[†]	1.00	-	-	1.00	-	-	1.00	-	-
Mild anemia	0.71	0.51	0.98	0.92	0.75	1.13	0.86	0.73	1.02
Moderate or severe anemia	0.56	0.34	0.92	0.59	0.41	0.84	0.57	0.43	0.77
Work status									
Works at home	0.62	0.24	1.56	1.26	0.85	1.86	1.12	0.80	1.56
Works outside	1.33	0.73	2.42	0.87	0.67	1.13	0.91	0.71	1.16
Does not work[†]	1.00	-	-	1.00	-	-	1.00	-	-
Religion									
Hindu[†]	1.00	-	-	1.00	-	-	1.00	-	-
Muslim	0.92	0.41	2.10	1.12	0.70	1.79	1.04	0.73	1.48
Sikh	1.11	0.80	1.55	0.84	0.64	1.11	0.93	0.73	1.18
Other	0.44	0.12	1.59	0.85	0.41	1.79	0.72	0.39	1.33
Caste/tribe									
SC/ST	0.86	0.57	1.28	0.71	0.55	0.92	0.76	0.61	0.95
OBC	0.90	0.56	1.43	0.83	0.64	1.08	0.85	0.67	1.08
Other[†]	1.00	-	-	1.00	-	-	1.00	-	-
Standard of living									
Low[†]	1.00	-	-	1.00	-	-	1.00	-	-
Medium	1.19	0.40	3.53	6.03	1.34	27.16	2.48	0.99	6.21
High	1.94	0.65	5.78	9.10	2.09	39.67	3.70	1.52	9.02
State									
Delhi[†]	1.00	-	-	1.00	-	-	1.00	-	-
Punjab	1.55	1.02	2.34	1.22	0.94	1.59	1.28	1.02	1.60
Number of women	1,190			2,526			3,716		

[†] Reference category

LL: Lower Limit; UL: Upper Limit

NA: Not applicable

Table 5. Adjusted effects (odds ratios) of body mass index (BMI) on the risk of adverse pregnancy outcomes (miscarriage or stillbirth) among women age 15-49 in Delhi and Punjab, 1998-99

Characteristic	15-29 OR	95% CI LL	95% CI UL		30-49 OR	95% CI LL	95% CI UL
Body mass index							
Underweight (BMI<18.5)	1.07	0.75	1.54		1.37	1.01	1.87
Normal (18.5≤BMI<25.0)[†]	1.00	-	-		1.00	-	-
Overweight (25.0≤BMI<30.0)	1.57	1.06	2.33		1.15	0.90	1.46
Obese (BMI ≥ 30.0)	2.10	1.02	4.29		0.84	0.58	1.22
Residence							
Urban	0.87	0.54	1.39		1.11	0.84	1.47
Rural[†]	1.00	-	-		1.00	-	-
Education							
Illiterate[†]	1.00	-	-		1.00	-	-
Literate, <middle complete	1.28	0.83	1.98		1.29	0.95	1.76
Middle complete	0.78	0.45	1.34		1.74	1.19	2.55
High school or more	0.85	0.49	1.48		1.40	0.98	1.99
Media habits							
Watches TV every week	1.49	0.92	2.41		1.03	0.76	1.38
Reads newspaper/magazine every week	0.85	0.56	1.27		0.83	0.61	1.12
Food habits							
Milk or curd daily	0.78	0.54	1.14		0.88	0.68	1.14
Fruits daily	1.07	0.68	1.71		0.91	0.69	1.22
Green, leafy vegetables daily	0.71	0.53	0.95		0.96	0.74	1.23
Eggs at least weekly	1.29	0.83	2.01		1.23	0.91	1.66
Chicken, meat, or fish at least weekly	0.69	0.36	1.30		0.90	0.60	1.35
Work status							
Works at home	0.92	0.38	2.23		0.85	0.52	1.38
Works outside	1.06	0.58	1.93		1.21	0.93	1.57
Does not work[†]	1.00	-	-		1.00	-	-
Religion							
Hindu[†]	1.00	-	-		1.00	-	-
Muslim	0.83	0.39	1.74		1.63	0.99	2.67
Sikh	0.61	0.41	0.90		0.91	0.69	1.21
Other	1.44	0.57	3.65		1.33	0.65	2.75
Caste/tribe							
SC/ST	0.74	0.48	1.12		0.98	0.71	1.36
OBC	0.82	0.53	1.28		0.94	0.70	1.25
Other[†]	1.00	-	-		1.00	-	-
Standard of living							
Low[†]	1.00	-	-		1.00	-	-
Medium	0.44	0.21	0.90		1.08	0.60	1.97
High	0.43	0.19	0.98		0.84	0.43	1.64
State							
Delhi[†]	1.00	-	-		1.00	-	-
Punjab	1.45	0.94	2.22		1.08	0.82	1.41
Number of women		1,560				2,908	

[†] Reference category

LL: Lower Limit; UL: Upper Limit