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Effects of Sedentary Lifestyle and Dietary Habits on Body Mass Index Change among Adult Women in India: Findings from a Follow-Up Study

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Abstract

We examined the effects of sedentary lifestyle and dietary habits on body mass index (BMI) change in a follow-up study of 325 women (aged 15–49 years) in Delhi, systematically selected from the 1998–1999 National Family Health Survey samples who were re-interviewed after 4 years in 2003. Information was collected on height, weight, dietary habits, and sedentary lifestyle through face-to-face interviews. Overall, a 2.0-point increase in mean BMI was found among women in just 4 years. Every second normal-BMI woman, two in five overweight women, and every fourth obese woman experienced a > 2.0-point increase in her mean BMI. High sedentary lifestyle (OR: 2.63; 95% CI: 1.29–5.35) emerged as the main predictor of a > 2.0-point increase in mean BMI in adjusted analysis, but there was weak evidence of association with the dietary covariates. Our findings suggest that a high sedentary lifestyle is a determinant of weight gain among adult women in urban India.

Keywords

change in BMI; dietary habits; follow-up study; India; obesity; sedentary lifestyle; women

Height, weight, and body mass index (BMI) have been used extensively as indicators of weight-related health problems (Bjørnelv et al. 2007). Changes in these anthropometric characteristics reflect different changes in society as well as in its individuals. Increased weight and BMI might also indicate an unhealthy diet and too little physical activity causing health problems. In order to prevent and modify any unwanted changes in weight and BMI, it is important to observe trends in the BMI-distribution over time. Different changes may call for different or new prevention strategies (Neumark-Sztainer 2005).

India is in the midst of a demographic, epidemiological, and nutrition transition. A growing population, increasing urbanization, a shift in the patterns of diseases and changes in

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lifestyle characterize this transition (Shetty 2002). The past decade has seen a dramatic increase in lifestyle-related chronic diseases including obesity, diabetes mellitus, cardiovascular disease, hypertension, stroke, and all cancers (WHO 2003).

Once considered a problem related to affluence, obesity is fast increasing and a significant proportion of overweight and obese people now coexist with those who are undernourished (Popkin 2002). Behavioral–lifestyle factors, in particular diet and physical activity, are the major causes of obesity. A diet high in saturated fats and sugars and low in fruit and vegetables has been identified as one of the leading risk factors for obesity (WHO 2004; World Cancer Research Fund 2007). Urbanization has been linked to increased Western food consumption in many developing societies as the process of urbanization automatically brings with it changes in dietary practices and physical activity pattern (Canan et al. 2005; Sobngwi et al. 2002; Schneider 2000; WHO 2003; Bell, Ge, and Popkin 2002; Popkin 2002; Popkin et al. 2001). In India, the level of urbanization is still comparatively low (31.2% according to the Census of India 2011), and thus there is considerable scope for increasing urbanization and population concentrations in the larger cities. Globalization, which has made cheap vegetable oils and fats widely available greatly increasing fat consumption in all nations (Drewnowski and Popkin 1997), is also contributing to the rise of obesity in India. In the near future, therefore, obesity is likely to emerge as a challenge to the health system in India.

In the past, governments in many developing countries with high levels of under nutrition and high prevalence of communicable diseases, paid little attention to the problems of overweight and obesity. Now, with a rapidly growing obesity epidemic and associated chronic diseases, the picture is beginning to change. This study aims to examine the effects of sedentary lifestyle and dietary habits on changes in the BMI status among adult married women in Delhi, India.

Methods

Study Location and Population

This article utilizes data collected for the first author's doctoral dissertation, entitled "Dynamics of Obesity among Women in India: A Special Reference to Delhi." Full details of the study have been presented elsewhere (Agrawal 2004). Briefly, during May–June 2003, a follow-up survey was carried out in the national capital territory of Delhi using the same sample derived from the National Family Health Survey-2 (NFHS-2) conducted during 1998–1999. NFHS-2 collected demographic, socioeconomic, and health information from a nationally representative sample of 90,303 ever-married women aged 15 to 49 years in all 29 states of India including Delhi. Details of sample design, including sampling frame are provided in the national survey report (International Institute for Population Science [IIPS] and ORC Macro 2000). In a follow-up survey four years later, 325 women aged 15 to 49 years, systematically chosen from the 1998–1999 NFHS-2 Delhi samples, were re-interviewed in 2003 using a structured questionnaire. Their weights and heights were again recorded (using the same equipment used in NFHS-2) to compute their BMI at the time of the follow-up interview. In addition to these measurements, detailed information was collected on their dietary habits and levels of sedentary lifestyle along with other

sociodemographic characteristics. Delhi which has a heterogeneous, multicultural population representative of the Indian urban scenario was chosen as the preferred location for this study.

Sample Selection, Response Rate, and Sample Size

Earlier studies on obesity in India have shown that overweight and obesity are predominant in urban areas (Agrawal 2002; Agrawal and Mishra 2004; Agrawal 2004; Agrawal, Mishra and Agrawal 2011). Therefore only urban Primary Sampling Units (PSUs) were chosen for the follow-up survey in Delhi. The sample frame for the follow-up survey was fixed to include women in all BMI categories and literacy levels. The aim was to have a sample size of at least 300 women, 100 from each of the three BMI categories (normal, overweight, and obese). At the time of revisit, several issues such as migration, change of address, non-response and non-availability of respondents tend to reduce the desired sample size. Potential loss during follow-up was dealt with increasing the initial sample size to get the desired sample size for the study.

In NFHS-2 Delhi sample, 1,117, 500, and 203 women respectively were normal, overweight and obese. In NFHS-2 survey questionnaire respondents were asked, “Would you mind if we come again for a similar study at some future date after a year or so?” Those women who objected for a revisit were excluded from the follow-up survey, and thus there remained 1,050 normal, 476 overweight, and 177 obese women in the sampling frame. Samples were drawn from each of these three categories through systematic stratified random selection using a random number. From normal BMI category, every fourth woman was drawn for the sample. Similarly, from the overweight category every second woman was drawn. In the obese category all women were included in the sample frame to get the desired sample size. This resulted into selection of a total of 677 women, 262 normal, 238 overweight, and 177 obese. For the follow-up survey, the addresses of the selected women were obtained from the NFHS-2 Household Questionnaires. Sample size was further reduced due to non-availability of some questionnaires and non-identified addresses. Finally, a total of 595 women—217 normal, 227 overweight, and 151 obese—were selected for the follow-up interview. Details of the sample selection and response rate is illustrated in the flow-chart (figure 1).

In the follow-up survey, 57% of the visited sample (337 women) were successfully interviewed—113 normal, 124 overweight, and 100 obese women. Of the sample, 43% (258 women) could not be interviewed as they were out of station (16%), had migrated (22%), house not found (1%), died (1%), or refused for an interview (3%). Women who were pregnant ($n = 9$) at the time of the follow-up survey and women who had given birth during the two months preceding the survey ($n = 3$) have been excluded from the analysis. Therefore, the findings are based on the remaining 325 respondents of the follow-up survey.

A separate analysis using NFHS-2 data shows that the sociodemographic characteristics of those interviewed and those who we could not be interview in the follow-up survey were similar (data not shown) indicating that the follow-up sample is quite representative of the study population.

Anthropometric Measurements

In NFHS-2 as well as in the follow-up survey, each ever-married woman was weighed using a solar-powered scale with an accuracy of ± 100 gms. 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. These data were used to calculate their individual body mass index (BMI). Practical and clinical definitions of overweight and obesity are based on the BMI, which is computed by dividing weight (in kilograms) by the square of height (in meters) (kg/m^2). A woman with a BMI between 25 and 30 is considered to be overweight, a BMI of more than 30 is considered to be obese. A woman with a BMI between 18.5 and 24.9 is considered normal, and if the BMI is below 18.5 the woman is considered to be underweight (WHO 1995).

Response Variable

Anthropometric measurements were obtained from women during NFHS-2 and also in the follow-up survey in 2003 to compute point change in mean BMI status. Therefore the change in mean BMI status is the main outcome of interest in this study.

Predictor Variables

The main predictor variables explored in this study pertains to dietary habits and sedentary lifestyle. Dietary information was collected in terms of frequency and amount of consumption of some specific food items in the household. Respondents were questioned on frequency (daily, weekly, monthly, occasionally/never) of consumption of food items such as milk, fried foods, sweets, junk foods (such as ice creams, soft drinks), and fast foods from restaurants. Information on consumption of fats and oil such as ghee, oil, and sugar were obtained at the household level as it was not possible to segregate their use at the individual level. An indirect consumption amount of these items at the individual level was estimated by dividing the total consumption of those items by total number of household members.

Sedentary lifestyle is due to a number of factors and is difficult to measure. In the present study level of sedentary lifestyle among women was examined on the basis of the following questions, which were asked to every woman during the time of personal interview. The questions were (1) Do you have any full-time or part-time maid in your house to help you? (2) Mostly who does the following household activities: sweeping and swabbing, cleaning of utensils, cooking, washing clothes, other household chores? (3) How much time do you devote to watching television during a normal day? (see appendix table A1). A composite score for sedentary lifestyle was made based on values assigned to indicators and based on mean and closer value of ± of 0.5 standard deviation of the score value. The sedentary lifestyle index is categorized into three, as low, medium, and high (see appendix table A2).

Other background characteristics of the respondents that are included as potential confounders in the study are: age, education, working status (employment status in last 12 months), caste/tribe status, religion, and household standard of living. (For a full definition of variables see table 1.)

Statistical Methods

Data are analyzed using descriptive statistics as well as bivariate and multivariate methods. In multivariate analysis, binary logistic regression model has been used. Because of re-sampling, the proportion of normal, overweight and obese women collected in the follow-up data were not proportional to actual population. To restore the NFHS-2 sample proportion, the follow-up survey data have been assigned appropriate weights before the analysis (see appendix table A3).

Ethical Approval

The study received ethical approval from the International Institute for Population Science's Ethical Review Board. Informed consent was obtained from all respondents in both NFHS-2 survey and the follow-up survey before asking questions and before obtaining measurements of their height and weight. The analysis presented in this study is based on secondary analysis of existing survey data with all identifying information removed.

Results

Characteristics of the Study Population

Table 1 presents percent distribution of women who were interviewed in NFHS-2 Delhi survey and in the subsequent follow-up survey in 2003, according to some selected background characteristics. The characteristics of women in the follow-up survey are almost similar to NFHS-2, which confirms that the samples selected in the follow-up survey are representative of Delhi. Almost half the respondents were 40 years and above and 15% were under 30 years of age. The mean age of the respondents was 38.2 years. Nearly half the study population had completed high school education while one-fifth was illiterate. Over 80% of the respondents were Hindu, the rest being Sikh, Muslim, and Others. Regarding caste/tribe distribution, "Other" castes were predominant, followed by Scheduled Castes or Scheduled Tribes and "Other Backward Class." More than four-fifth of the respondent belonged to households with a higher standard of living whereas less than 20% women belonged to households with a medium or lower standard of living. More than 9 out of 10 respondents were not working.

Change in the Mean BMI

Table 2 presents absolute changes in the mean BMI level of women in Delhi between NFHS-2 in 1998–1999 and the follow-up survey in 2003. Overall, there has been an average increase of 2.0 points in mean BMI levels in the four years between the two surveys. Women with a normal BMI at the time of NFHS-2 survey added the maximum—an almost 2.4-point increase in their mean BMI level at the follow-up stage. Overweight and obese women added a 1.5 and 0.5-point increase in their mean BMI levels, respectively. Half the women with a normal BMI experienced an increase of more than 2.0 points in their mean BMI levels from 1999 to 2003, followed by 39% of overweight women and 24% of obese women.

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Sedentary Lifestyle and Change in Mean BMI

Table 3 presents change in mean BMI of women in the four years between 1999 and 2003 according to the level of sedentary lifestyle. Women who had a part-time maid in the house experienced almost a 3.0-point increase in their mean BMI, which increased to 6.0 points among those who had a fulltime maid. This is comparable to only 1.5-point increase among women who did not have a maid. Increases were also noticed in women's mean BMI status according to women's involvement in daily household chores like sweeping and swabbing, cleaning of utensils, cooking and washing clothes and the amount of time they spent in sitting and watching television (TV). These indicators have been put together to form a composite index of degrees of sedentary lifestyle and it was found that women with a medium level of sedentary lifestyle experienced about 2.0-point increase in their mean BMI, which increased to more than 3.0 points among women with a high-sedentary lifestyle, compared to only 1.4 points among women with a low-sedentary lifestyle.

Dietary Habits and Change in Mean BMI

Table 4 presents a change in mean BMI during the four years according to women's dietary habits. Women who consumed milk or curd on a daily basis experienced the maximum increase in the mean level of BMI (2.4 points) compared to those who consumed milk less frequently. Frequency of fruit consumption also showed a positive association with the increase in the mean BMI status of women. Consumption of non-vegetarian food items such as chicken, meat, or fish showed a mixed pattern of association with BMI. If consumption was more frequent like once a week, then increase in mean BMI was found to be relatively high, whereas a lesser increase in mean BMI level was found among women who consumed non-vegetarian items less frequently, such as once in a month. Interestingly, the increase in the mean BMI status of women was found to be higher among those who either did not consume non-vegetarian items at all or consumed them very occasionally. Daily consumption of fried foods, sweets, junk foods such as soft drinks and ice creams and consumption of fast food from restaurant at least once a month has shown an association with higher increase in the mean BMI level of women than those who consumed those less frequently although the association is not significant. Regular butter consumption, daily milk consumption of more than 0.25 liter, monthly ghee consumption of more than 250 grams was found to be associated with an increase in the mean BMI status of women but the association was insignificant. On the other hand monthly oil consumption of more than 500 grams has shown a positive association with a more than 2.0-point increase in mean BMI.

Effect of Sedentary Lifestyle and Dietary Habits on a More than Two-Point Increase in BMI Status

Table 5 presents both unadjusted and adjusted effects of sedentary lifestyle and dietary habits on more than a 2.0-point increase in mean BMI among women in Delhi, in two separate models. In the unadjusted analysis, women with a high level of sedentary lifestyle were found to be twice as likely (*OR*: 2.05; 95% CI: 1.15–3.64) to experience more than a 2.0-point increase in their BMI status compared to women with a low level of sedentary lifestyle. In the adjusted analysis, after controlling for dietary habits and sociodemographic factors, the effect of sedentary lifestyle (*OR*: 2.63; 95% CI: 1.29–5.35;p< .0001) still

emerged as a strong predictor of more than 2.0-point increase in BMI both in magnitude and in significance than in the unadjusted model. Women who were overweight (*OR*: 0.63; 95% CI: 0.38–1.04) or obese (*OR*: 0.29; 95% CI: 0.13–0.67) during 1999 were significantly less likely to experience a more than 2.0-point increase in their BMI, with reference to normal women and this association remained unchanged (*OR*: 0.26; 95% CI: 0.11–0.65) even in the adjusted analysis. However, women with high school and above education were found to be 2.4 times (*OR*: 2.35; 95% CI: 1.27–4.35) more likely to experience a more than a 2.0-point increase in their BMI status compared to illiterate women, but this association slightly attenuates in the adjusted analysis. The association between dietary variables such as consumption of sweets, soft drinks, fast food from restaurants, butter, milk, and other socioeconomic and demographic characteristics of women such as age, religion, caste/tribe status, standard of living, and employment status were not found significant either in the unadjusted or in the adjusted analysis.

Discussion

Our study found a significant positive increase in mean BMI levels of adult women in all three categories (normal, overweight, and obese) during the four-year period from 1999 to 2003. Overall, a 2.0-point increase in mean BMI was found among adult women in just four years (from 24.8 in 1999 to 26.8 in 2003) and every second normal BMI women, two in five overweight women and every fourth obese women experienced more than a 2.0-point increase in their mean BMI. Highest weight gain was found among women with a normal BMI. A strong evidence of association was found between sedentary lifestyle and the increase in mean BMI of women, rather than dietary habits and sociodemographic characteristics of women. The higher the level of sedentary lifestyle, the higher was the increase in the mean BMI among women over the four-year period.

A significant increase in the prevalence of obesity in almost all countries in the world has made obesity a global health problem. Obesity was labeled as “the global epidemic” by the WHO as early as in 1998. Studies have shown that changes in dietary patterns and physical activity levels associated with affluence and migration to urban areas have an influence on this. Obesity is the epidemic of the affluent in India, and this association is consistent at both the individual and ecological levels (Subramanian and Davey-Smith 2006). The tempo of migration and urbanization in India is also very high. It emerges from the present study that there have been significant increases in overweight and obesity among women in India, as represented by those living in Delhi. The present study shows that there has been a substantial increase in a sedentary lifestyle among the women in India which could severely aggravate the problem of obesity in future. Therefore, the condition of obesity in women in India cannot be put on the back burner and should command equal attention at the national level as under nutrition. The issue of tackling obesity among women becomes more important because of the fact that a child learns his eating habits and lifestyle pattern largely from his mother. Therefore women themselves should have a balanced dietary pattern and healthy lifestyle which they can hold up as an example to their children, which would help prevent the vicious cycle of intergenerational obesity. Efforts should be made to help Indian women to develop a healthy lifestyle and adopt healthy dietary habits from an early age.

Previous studies have shown that obesity results from excess energy intake, inadequate physical activity, and sedentary lifestyle (Wang 2004; Canan et al. 2005). However, our study shows that in the Indian urban scenario it is more the sedentary lifestyle that is responsible for the increase in overweight and obesity among women. A significant increase in the mean BMI level was found among women who had a maid in their house to do all the household chores and who were less involved in physically intensive household chores such as sweeping and swabbing, cleaning utensils, cooking, and washing clothes. Television-watching for long duration also came out as an important factor for weight gain among women. Watching TV not only reduces physical activity, but also tends to be associated with consumption of fast foods and junk snacks. On the other hand, monthly ghee or sugar consumption patterns have not shown any association with an increase in the mean BMI status of women. This may in part be due to imprecise measurement of these indicators. These indicators were collected at the household level and may be subject to reporting bias and other measurement errors. A larger increase in mean BMI status was found among women who frequently consumed junk foods or food items containing relatively more sugar and fats. A separate analysis for more than a 2.0-point increase in the mean BMI during the four years in question also substantiates the role of junk foods and food items containing more sugar and fats in increasing BMI levels among women.

Several strengths and potential limitations of our study deserve comment. Firstly, our study is based in the national capital territory of Delhi which inhabits a multicultural and multiethnic population representing India’s growing urban scenario. Second, there are dearth of studies in India which examines the change in body mass index (BMI) and its determinants based on the same sample of population through a follow-up study. Representative data at the national or state (Delhi) level on anthropometric measures is rare in India except the National Family Health Survey (NFHS)-3 conducted in 2005–2006 and NFHS-2 conducted in 1998–1999 which was used as a baseline for this study. Little/no empirical evidence of association between sedentary lifestyle and dietary habit on BMI change among women exists in India. For this reason this study is an important contribution to address this existing gap in knowledge in India.

Third, in this study we have considered married adult women to examine the effect of diet and lifestyle on BMI change. The reason for this being is that NFHS-2 confirmed the marked rural–urban differences in prevalence of obesity among women, and also we could find a rising trend of obesity among married women between the 2nd (IIPS and ORC Macro 2000) and 3rd NFHS-3 2005–2006 (IIPS and Macro International 2007). Studies in the developed countries also showed that women who enter pregnancy overweight or obese are at a greater risk for maternal and infant morbidity and mortality. Obesity increases the risk that a woman will enter pregnancy with a chronic disease (Grason and Mishra 2006). Furthermore, obese women are at an increased risk for complications in pregnancy such as infertility, gestational diabetes, gestational hypertension, and preeclampsia (Siega-Riz and Laraia 2006). Maternal BMI has also been linked to childhood overweight and obesity, making maternal nutrition and physical activity a key component of comprehensive childhood obesity prevention. Therefore we have chosen married women sample to address this important public health problem in India.

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Fourth, the variables considered for sedentary lifestyles are important to consider in an Indian context: availability of a maid in the household. A maid is a unique feature in Indian household who helps the women in her household chores such as sweeping and swabbing, cleaning utensils, cooking, washing clothes etc. In this study we found that availability of a maid in the household makes a woman more obese. It is likely that if a household have a maid to do the daily chores, the women are devoid of doing any daily household chores and thus indulge in sedentary lifestyle such as watching TV for longer hours which makes them susceptible to obesity and overweight.

A major limitation of this study is that lifestyle and dietary variables are complex and subject to measurement errors, in addition to reporting bias, which could lead to underreporting, interviewer bias, and the interviewers' inability to capture consumption of items such as oil, *ghee*, and sugar in Indian settings. Although rigorous methods, like cross checks and back-checks, were employed to achieve high data quality, such measurement errors cannot be ruled out. This may be partly why a clear association between these dietary variables and obesity has not been found in our study. Secondly, although we control for several key sociodemographic factors, there may be other potentially confounding characteristics and behaviors that were not measured in these surveys. Moreover, the surveys did not collect any information on genetic markers, which could mediate the relationships between lifestyle and diet factors considered in this study.

Nevertheless, finding of the study that a 2.0-point increase in mean BMI was observed among adult women in just four years and every second normal BMI women, two in five overweight women and every fourth obese women experience more than 2.0-point increases in their mean BMI has immense programmatic and policy relevance. Finding that sedentary lifestyle is the main predictor of increase in mean BMI is also important considering the increasing prevalence of obesity among Indian women. It is essential to develop anticipatory strategies which would impact on the society at large. Health service providers and the mass media can play a vital role in encouraging anti-obesity behaviors in society. Strategies for prevention and management of women's obesity should be integrated with existing public health system.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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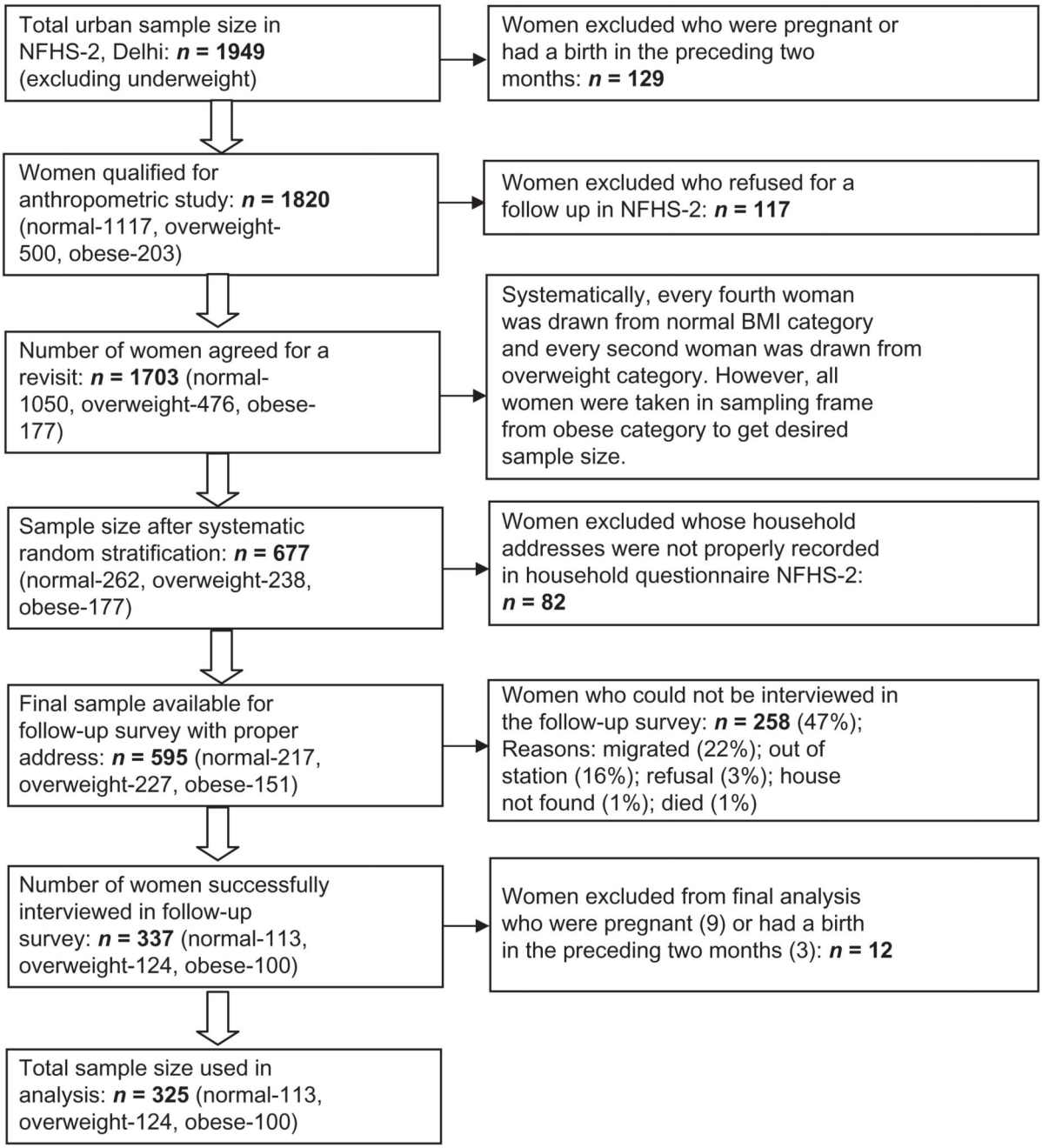

Figure 1.
Selection of sample in the follow-up survey and response rate.

Table 1

Background Characteristics of Respondents Who Were Sampled in NFHS-2, 1999, and in the Follow-Up Survey, 2003

	NFHS-2, 1999 respondents[a]		Follow-up survey, 2003 respondents[b]	
Background characteristics	**Percent**	**Number**	**Percent**	**Number**
Age				
20–29	15.4	280	14.0	45
30–39	40.1	730	35.6	116
40–54	44.5	810	50.5	164
Mean age	37.2	1821	38.4	325
Education[c]				
Illiterate	25.4	462	20.3	66
Literate but less than middle school complete	14.7	267	18.7	61
Middle school complete	11.0	201	15.2	49
High school complete and above	48.9	890	45.8	149
Religion				
Hindu	84.2	1534	83.1	270
Muslim	7.6	139	6.7	22
Sikh	5.7	104	7.6	25
Others[d]	2.4	44	2.6	8
Caste/tribe status[e]				
Scheduled caste/tribe	18.1	329	17.6	57
Other backward class	11.4	207	9.9	32
Others	70.5	1282	72.5	236
Standard of living index[f]				
Low/Medium	28.0	493	21.8	71
High	72.0	1269	78.2	254
Employment status				
Working	18.9	345	8.7	28
Not working	81.1	1475	91.3	297
Total	100.0	1821	100.0	325

[a] Background characteristics of NFHS-2 urban sample of Delhi corresponds to 1999 survey except for age.

[b] Background characteristics for the follow–up survey respondents corresponds to 2003 survey.

[c] Illiterate = 0 years of education; Literate but less than middle school complete = 1–5 years of education; Middle school complete = 6–8 years of education; High school complete and above = 9+ years of education.

[d] Sikh, Buddhist, Christian, Jain, Jewish, or Zoroastrian.

[e] Scheduled castes and scheduled tribes are identified by the Government of India as socially and economically backward and needing protection from social injustice and exploitation; Other backward class category is a diverse collection of intermediate castes that were considered low in the traditional caste hierarchy but are clearly above SC; “Others” is a default residual group that enjoys higher status in the caste hierarchy.

[f]Standard of living (SLI) was defined in terms of household assets and material possessions and these have been shown to be reliable and valid measures of household material well-being. It is an index which is based on ownership of a number of different consumer durables and other household items. Index scores range from 0–14 for low SLI to 15–24 for medium SLI to 25–67 for high SLI, and are calculated by adding the following scores: (1) *House type*: 4 for *pucca*, 2 for semi *pucca*, 0 for *kachcha*; (2) *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; (3) *Main fuel for cooking*: 2 for electricity, liquefied natural gas, or biogas, 1 for coal, charcoal, or kerosene, 0 for other fuel; (4) *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; (5) *Separate room for cooking*: 1 for yes, 0 for no; (6) *Ownership of house*: 2 for yes, 0 for no; (7) *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; (8) *Ownership of irrigated land*: 2 if household owns at least some irrigated land, 0 for no irrigated land; (9) *Ownership of livestock*: 2 if own livestock, 0 if not own livestock; and (10) *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.

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Table 2

Absolute Change in Mean BMI and Percentage of Women Who Experienced a > 2.0-Point Change in BMI between 1999 and 2003 by BMI Status of Women in 1999, Delhi, 2003

BMI Status in 1999	Mean BMI during 1999	Mean BMI during 2003	Point increase in mean BMI	Percentage of women experienced > 2.0-point increase in mean BMI	Number of women
Normal	22.0	24.5	2.4	50.0	198
Overweight	27.3	28.8	1.5	38.5	91
Obese	33.9	34.4	0.53	23.8	36
Total	24.8	26.8	2.0	43.7	325

Table 3

Absolute Change in Mean BMI and Percentage of Women Who Experienced a > 2.0-Point Change in Mean BMI between 1999 and 2003 According to Availability of a Maid in the House and Performance of Household Chores, Delhi, 2003

Performance of household chores	Point increase in mean BMI	Percentage of women experienced > 2.0-point increase in mean BMI	Number of women
Availability of maid *			
No maid	1.51	40.1	242
Maid works part-time	2.91	52.7	74
Maid works full-time	6.01	70.0	10
Sweeping and swabbing *			
Done by women only[a]	1.40	36.3	136
Done by women with others[b]	1.87	45.1	102
Done by others[c]	2.93	53.4	88
Cleaning of utensils			
Done by women only[a]	1.40	38.6	140
Done by women with others[b]	1.90	44.1	102
Done by others[c]	2.98	51.2	84
Cooking **			
Done by women only[a]	1.71	39.3	197
Done by women with others[b]	2.21	48.7	113
Done by others[c]	3.44	62.5	15
Washing clothes			
Done by women only[a]	1.75	41.2	170
Done by women with others[b]	1.75	43.0	93
Done by others[c]	2.85	52.4	63
Hours of television watched *			
Less than one hour/day	1.43	37.2	113
One to two hours/day	2.10	43.9	138
More than two hours/day	2.53	53.4	74
Level of sedentary lifestyle *			
Low	1.44	38.6	145
Medium	1.82	42.7	109
High	3.26	56.3	71
Total	2.0	43.7	325

[a] Women only mean that a woman is the only one in the family who does this chore.

[b] Women with others means that the chore is sometimes done by a woman and sometimes by a maid or a family member.

[c] Others means that the chore is done only by the other family members or a maid in the household.

*$p < .05$;

**$p < .10$.

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Table 4

Absolute Change in Mean BMI and Percentage of Women Who Experienced a > 2.0-Point Increase in Mean BMI between 1999 and 2003 According to Frequency of Dietary Intake and Average Consumption of Fats, Oils and Sugar, Delhi, 2003

Frequency of dietary intake	Point increase in mean BMI	Percentage of women experienced > 2.0-point increase in mean BMI	Number of women
Consumption of milk or curd**			
Daily	2.4	49.5	201
Once a week	1.4	33.3	69
Once a month	0.8	31.4	35
Occasionally or never	1.9	42.9	21
Consumption of fruits *			
Daily	2.4	51.8	164
Once a week	2.1	42.3	70
Once a month	1.4	37.3	51
Occasionally or never	0.5	22.5	41
Consumption of chicken, meat, or fish *			
Once a week	2.2	47.9	48
Once a month	1.9	26.5	49
Occasionally or never	1.9	46.9	229
Consumption of fried foods			
Daily	2.1	35.3	17
Once a week	1.7	41.5	54
Once a month	2.0	44.0	159
Occasionally or never	2.0	46.3	95
Consumption of sweets			
Daily	2.8	52.6	19
Once a month	1.9	43.9	173
Occasionally or never	1.9	42.1	133
Consumption of soft drinks			
Daily	2. 7	49.6	127
Once a month	1. 7	40.4	89
Occasionally or never	1.4	39.4	109
Consumption of ice creams			
Daily	2.7	43.5	61
Once a month	2.2	49.1	105
Occasionally or never	1.5	40.3	159
Eating fast foods from restaurant			
At least in a month	2.7	46.7	45
Occasionally or never	1.8	43.2	280
Regular butter consumption			
No	1.6	41.4	198

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Frequency of dietary intake	Point increase in mean BMI	Percentage of women experienced > 2.0-point increase in mean BMI	Number of women
Yes	2.5	47.2	128
Daily milk consumption			
Up to 0.25 L	1.4	41.5	130
More than 0.25 L	2.3	45.1	195
Monthly ghee consumption			
Up to 250 g	2.0	43.7	183
More than 250 g	1.9	44.1	143
Monthly oil consumption *			
Up to 500 g	1.9	37.1	104
More than 500 g	2.0	47.1	221
Monthly sugar consumption			
Less than 1 kg	2.0	44.0	141
More than 1 kg	1.9	43.5	185
Total	2.0	43.7	325

* $p < .05$.

Table 5

Unadjusted and Adjusted Odds Ratio with 95% Confidence Interval (OR with 95% CI) Showing the Effect of Sedentary Lifestyle and Dietary Habits on a > 2.0-Point Change in the Mean BMI Level among Women between 1999 and 2003, Delhi, 2003

	Unadjusted		Adjusted	
Selected predictors	**OR**	**95% CI**	**OR**	**95% CI**
Level of sedentary lifestyle				
Low[R]	1.00		1.00	
Medium	1.18	0.71,1.95	1.49	0.83,2.67
High	2.05**	1.15,3.64	2.63*	1.29,5.35
Consumption of sweets				
Once a week[R]	1.00		1.00	
Once a month	0.68	0.26,1.75	0.73	0.25,2.16
Occasionally or never	0.62	0.24,1.62	0.61	0.20,1.84
Consumption of soft drinks				
Once a week[R]	1.00		1.00	
Once a month	0.69	0.40,1.19	0.76	0.40,1.42
Occasionally or never	0.66	0.39,1.11	0.81	0.42,1.57
Eating fast foods from restaurant				
At least in a month[R]	1.00		1.00	
Occasionally or never	0.85	0.46,1.60	1.30	0.61,2.78
Regular butter consumption				
No[R]	1.00		1.00	
Yes	1.26	0.80,1.97	1.19	0.68,2.10
Daily milk consumption				
Less than 0.250 L[R]	1.00		1.00	
More than 0.250 L	1.18	0.75,1.84	1.06	0.57,1.97
Age				
20–29[R]	1.00		1.00	
30–39	1.69	0.85,3.38	2.18***	0.99,4.79
40–54	0.60	0.31,1.17	0.77	0.34,1.73
Education				
Illiterate[R]	1.00		1.00	
Literate, < middle school complete	2.39**	1.15,4.93	2.18***	0.93,5.12
Middle school complete	0.95	0.43,2.13	1.18	0.46,3.02
High school complete and above	2.35*	1.27,4.35	2.27***	0.97,5.34
Religion				
Hindu[R]	1.00		1.00	
Muslim	1.01	0.42,2.44	1.46	0.51,4.16
Others	1.77	0.86,3.67	1.89	0.83,4.32
Caste/tribes				

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	Unadjusted		Adjusted	
Selected predictors	**OR**	**95% CI**	**OR**	**95% CI**
Scheduled caste/scheduled tribe[R]	1.00		1.00	
Other backward class	1.01	0.42,2.42	1.05	0.39,2.85
Others	1.08	0.61,1.94	0.68	0.31,1.46
Standard of living index				
Low/Medium[R]	1.00		1.00	
High	1.09	0.64,1.85	0.82	0.42,1.60
Employment status				
Working[R]	1.00		1.00	
Non-working	1.69	0.78,3.66	1.44	0.60,3.46
BMI Status in 1999				
Normal[R]	1.00		1.00	
Overweight	0.63***	0.38,1.04	0.64	0.36,1.15
Obese	0.29*	0.13,0.67	0.26*	0.11,0.65
Number of women	325		325	

* $p < .001$;

** $p < .05$;

*** $p < .10$.