Emerging Obesity among Married Indian Women: Role of Changing Lifestyle and Diet

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Abstract

This paper examines the changes in the Body Mass Index (BMI) of married Indian women according to lifestyle and dietary habits by analysing the primary data collected from 325 women (aged 15-49) as a follow-up of 1998-99 NFHS-2 in Delhi. Information on women's BMI, dietary habits, and sedentary lifestyle was collected through structured questionnaires. There was a significant increase in overweight and obesity among married women in Delhi during 1999 and 2003. Women who were less physically active, who had a sedentary lifestyle, and who frequently consumed sugary and fatty items experienced significant increases in their BMI levels. Sedentary lifestyle emerged as the main predictor of increase in BMI of women in the adjusted multivariate analysis. Attention should be paid to overweight and obesity problems now coexisting with undernutrition in India. Healthy lifestyles and dietary habits should be promoted vigorously to tackle this emerging health threat in India.

Key words- Obesity, BMI, sedentary lifestyle, dietary habits, women, Delhi, India

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Introduction

Obesity is increasing at an alarming rate throughout the world and has become a global health problem. The World Health Organisation (WHO) has declared overweight as one of the top 10 health risks in the world and one of the top five in developed nations (WHO, 2002). WHO stated that, "the growth in the number of severely overweight adults is expected to be double than under-weight during 1995-2025" (WHO, 1998). According to a recent estimate total numbers of overweight and obese adults in 2005 were 937 million and 396 million respectively, accounting for 23.2 percent and 9.8 percent of the world's adult population. By 2030, the absolute numbers were projected to total 2.16 billion overweight and 1.12 billion obese individuals adjusting for secular trends (Kelly *et al.,* 2008).

Once considered a problem related to affluence, obesity is now fast growing in many developing countries and in poor neighbourhoods of the developed countries (WHO, 2003; WHO, IASO, & IOTF, 2000). Even in countries like India, which are typically known for high prevalence of undernutrition, a significant proportion of overweight and obese people now coexist with those who are undernourished (Popkin, 2002). The National Family Health Survey (NFHS-2), conducted during 1998-99 shows 6 percent obesity with a BMI of 30 or more and 18 percent overweight with a BMI between 25-30 in urban India among married women aged 15-49 years (IIPS and ORC Macro, 2000). The overweight and obesity proportions have risen almost unnoticed in the country.

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, 1998; Popkin *et al.,* 2001; Drewnowski & Popkin, 1997). Because of urbanization and modernization, lives have become more sedentary and less physically active than before. Urbanization involves changes in occupation patterns, life-styles, family structures and value systems. These changes have an impact on dietary practices and the levels of physical activity.

The etiology of obesity is multi factorial. Poor diet and physical inactivity cause overweight and obesity. This imbalance between food intake and energy expenditure is determined, in large part, by the socioeconomic context. Although obesity is affected by interaction between multiple genes and the environment, the genetic pool is not changing rapidly; it is the environmental and social context that has changed and caused the epidemic (Clement & Ferre, 2003). Problems of overweight and obesity are caused by a chronic imbalance between energy intake and actual energy needs of the body. The metabolic factors concerned include a low metabolic rate, low insulin sensitivity and high respiratory quotient. In addition, various socio-demographic factors such as smoking habits, dietary habits, socio-economic situation, education level, use of contraceptives, postpartum status and rapid weight gain in childhood, have been recognized as modifying factors (Bray, 1999).

In a study among married women in northern India by Agrawal and Mishra (2004), it was found that urban residence significantly increases the risk of obesity. The transition from a rural to an urban lifestyle is associated with increased levels of obesity, which has been linked with dramatic changes in lifestyles (e.g. increased consumption of high energy dense foods and decrease in physical activity). Urban residence and higher income were associated with lower energy intake, higher fat intake, and lower physical activity level compared to rural residence and other income categories (Canan *et al.,* 2005; Sobngwi *et al.,* 2002; al-Mannai *et al.,* 1996; Popkin *et al.,* 1994; Kadyrova & Salkhanov, 1990).

Food habits are the way in which individuals or groups of people respond to social and cultural pressures, choose, consume, and make use of available foods (Mead, 1962). As populations become more westernised, dietary composition changes to include more saturated fat and less fibre. Although this leads to more energy-dense diets, the actual energy intake may not be greater (Taylor *et al.,* 1992). According to de Garine (1969), urban food habits depend first on traditional food habits at home and second on new influences, for instance eating in workers' canteens. According to Popkin (1996), an urban population has a distinctly different diet from a rural population. Urban diets include superior grains, more milled and polished grains, higher fat content, more animal products, more sugar, and more prepared and processed food. Where nutrition transitions occur, the impacts are usually seen first among the affluent, than among the lower income classes (Delpeuch & Marie, 1997).

Need and Objective of the study

The process of urbanisation automatically brings with it changes in the activity pattern (Schneider, 2000). Still, in India the level of urbanization is comparatively very low (27.8% according to Census 2001). There is much scope for increasing urbanization and concentration of population in larger cities in India. Again, globalisation is also playing an important role in modernization and sedentary lifestyle in India. Globalisation has made cheap vegetable oils and fats widely available, greatly increasing fat consumption in all nations (Drewnowski & Popkin, 1997). So, in the near future, obesity is likely to emerge as a challenging problem for India. Though the problem of obesity is still in the early stages in India compared to western countries, it nevertheless needs to be tackled aggressively before it assumes serious epidemic proportions.

In the past, governments in many developing countries with high levels of under nutrition and high prevalence of communicable diseases have paid little attention to the problems of overweight and obesity. Now, with a rapidly growing obesity epidemic and associated chronic diseases, the situation is beginning to change. Health care providers and policy makers need to appreciate this important and emerging problem of obesity and pay more attention to develop effective policies and programmes to prevent obesity. From this point of view, an intensive research on the dynamics of obesity is needed to understand this upcoming health issue and formulate effective programmes to enhance the quality of life of the people. However, due to paucity of data, understanding of this rapidly growing public health threat remains poor. Therefore, this study is an attempt to understand the dynamics of obesity among Indian women with the specific objective to examine the

changes in the status of Body Mass Index (BMI) according to sedentary lifestyle and dietary habits in India's national capital territory of Delhi.

Data and Methods

The study has been carried out with primary data based on a follow-up survey (2003) of 325 women included in NFHS-2 (1999) in India's national capital territory of Delhi. The NFHS-2 was designed on the lines of the Demographic and Health Surveys (DHS) that have been conducted in many developing countries since the 1980s. NFHS-2 collected demographic, socio-economic, and health information from a nationally representative sample of 90,303 ever-married women aged 15–49 years residing in India's 92,486 households. All states of India are represented in the sample (except the Union Territories), covering more than 99 percent of the country's population. The sample is a multi-stage random sample with an overall response rate of 98 percent. Details of sample design, including sampling frame and sample implementation are provided in the national survey report (IIPS and ORC Macro, 2000).

The follow-up survey was conducted during May-July 2003 for a sub-sample of ever-married women aged 15-49 years in the national capital territory of Delhi. Delhi inhabits a heterogeneous population representing India's urban scenario. Women, who were interviewed during NFHS-2, during 1999, a sub-sample of them were reinterviwed through structured questionnaires in the follow-up survey in 2003 to measure their weight and height (with the same equipments used in NFHS-2) to compute their present BMI. In addition to these measurements, detailed information was collected on their dietary habits and levels of sedentary lifestyle.

Measurements of obesity

In NFHS-2 as well as in the follow-up survey, each ever-married woman were weighed using a solar-powered scale with an accuracy of $\pm$ 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. The weight and height data have been used to calculate the body mass index (BMI). The practical and clinical definitions of overweight and obesity are based on the body mass index (BMI), which is computed through dividing weight (in kilogram) by the square of height (in meter) [kg/m^2]. BMI can be used to estimate the prevalence of underweight, as well as the prevalence of overweight and obesity. A woman between BMI of 25.0-30.0 is considered as overweight, and more than 30 as obese. However, a woman with BMI between 18.5 to 24.9 is considered as normal and below 18.5 as underweight.

Risk factors and confounders

The primary risk factors of obesity included in this study are some indicators of dietary habits and sedentary lifestyle. Dietary information was collected in terms of frequency as well as direct and indirect intake of amount of some specific food items. Consumption of food items such as milk, fried foods, sweets, junk foods such as ice creams, cold drinks

and fast foods were asked to the respondents and their frequency of intake was asked in terms of daily, weekly, monthly, occasionally and never. Information on consumption of some specific ingredient of Indian food items such as *ghee,* oil and sugar which are commonly used, 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 has been estimated by dividing the total consumption of the items by total number of household members. However, wherever possible a direct daily consumption pattern was asked to the respondent for food items such as milk and butter.

Sedentary lifestyle is a complex phenomena and it is difficult to measure. Several indicators which govern sedentary lifestyle of women include, for example, her involvement in different household works such as sweeping and swabbing, cleaning, cooking, washing cloths, etc. were captured in the survey by asking about women's involvement in these activities. Also, their exercise habits, availability of maid, etc. were asked to understand the level of sedentary lifestyle. As the complexity of these indicators could not be captured through a single variable, a composite index of sedentary lifestyle has been created by combining all the above indicators. Based on the distribution of composite scores, women were grouped into three categories of sedentary lifestyle: low, medium and high.

The 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), ethnicity, religion, and household standard of living.

Selection of Sample for the follow-up survey

Earlier studies on obesity in India have shown that overweight and obesity are predominant in urban areas (Agrawal, 2002, 2004). Moreover, a large majority proportion of Delhi's population was urban (more than 90%). Therefore, only urban PSUs (Primary Sampling Units) were taken for the follow-up survey. Selection of sample for the follow-up survey was done according to the levels of BMI and literacy among women as implicit for stratification to get all types respondents in the sample. It was proposed to achieve a sample of at least 300 women, 100 from each of the three BMI groups (normal, overweight, and obese) in the follow-up survey. Women with BMI below 18.5 were excluded because underweight was not the theme of the study. There are several issues such as migration, change of address, non-response and non-availability of the women at the time of revisit which substantially decreases the desired sample size to achieve in a follow-up survey. A study by Roy *et al.* (2003) has shown that only 56 percent of women could be re-interviewed in a follow-up survey of a sub-sample of the first National Family Health Survey (NFHS-1) after six years. Such potential loss to follow-up was taken into account in the design of the follow-up survey for our study.

In urban PSUs of NFHS-2 Delhi sample, 1123, 500, and 191 women were normal, overweight and obese, respectively. In the NFHS-2 survey instrument there was a question: "*Would you mind if we come again for a similar study at some future date after a year or so?*" Women, who did not agree for a revisit, were 73, 24 and 14, respectively in the above three categories. These women were excluded in the follow-up study due to

ethical considerations. Excluding the women who did not agree with the revisit, 1050, 476, and 177 women were left in the three categories, respectively. Samples were drawn from each of the three above strata with the help of systematic stratified random sampling. From the first strata, every fourth woman was drawn with a random number. Similarly, from the second strata every second woman was drawn. On the other hand, there was no choice to reduce the sample from the third strata to achieve the target sample size, so every woman was taken. In this way, a total of 677 women were selected, 262 normal, 238 overweight and 177 obese. While taking their addresses from the NFHS-2 Delhi's Household Questionnaire for the follow-up survey, samples were again reduced because of the non-availability of some interview schedules or lack of proper household address for few. Finally, a total of 595 women; 217 normal, 227 overweight and 151 obese were selected for interview in the follow-up survey for whom addresses could be noted.

In the follow-up survey, a total of 57 percent cases (n=337), 113 normal, 124 overweight and 100 obese women were found. However, 43 percent cases (n=258) were not found because they were out of station (16 percent), they had shifted (22 percent), they had died (1 percent), they could not be found (1 percent) or they refused (3 percent) (Fig. 1.1). A separate analysis using NFHS-2 data shows that the socio-demographic characteristics of found and not found women in the follow-up survey were almost similar (data not shown) so the follow-up samples are well representative of the study population.

Analysis

Data are analyzed using both descriptive statistics and bi-variate and multivariate methods. In the multivariate analysis, binary logistic regression model has been used. Women who were pregnant (n=9) at the time of the survey and women who had given birth during the two months (n=3) preceding the survey have been excluded from the analysis. Therefore, the result of this study is based on remaining 325 cases of follow-up data. Because of 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, an appropriate sample weight has been applied to the follow up data for the analysis.

Human Subjects Informed Consent

Analysis presented in this paper is based on analysis of data with all identifier information removed. Informed consent was obtained from all respondents in both the NFHS-2 and the follow-up survey before asking questions and before obtaining measurements of height and weight.

Results and Discussion

At the outset, it is important to know the background characteristics of the study population. Table 1 presents the percent distribution of women who were interviewed in NFHS-2 Delhi survey and in the follow-up survey 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. The age distribution shows that almost half the respondent were 40 years and above whereas, 15 percent respondent were less than 30 years of age. The mean age of the respondents was 38.2 years. Educational status of nearly half the study population was high school and above whereas every fifth woman was illiterate.

More than 80 percent of the respondents were Hindus. The rest comprises of Sikhs, Muslims and others. Of the respondents' caste/tribes distribution, 'others' castes were predominant, followed by scheduled castes or scheduled tribes and 'other backward class.' More than four-fifths of the respondents belonged to households with a higher standard of living whereas less than 20 percent 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 BMI status of women in Delhi during the NFHS-2 in 1999 and the follow-up survey in 2003. Overall, an average increase of 2 points in the level of BMI has been found during the four years between the two surveys. Women with a normal BMI status at the time of NFHS-2 survey added the maximum (almost 2.4 points) in their BMI level. Also, overweight and obese women added about one and half and one point increase in their BMI level, respectively. However, medically obese women experienced a slight decline (less than 1 point) in their mean BMI in the four–year period.

Women who had experienced more than 2 point increase in the mean BMI during the four years have also been analysed separately and presented in Table 2. It is found that every second woman with normal BMI experienced an increase of more than 2 point followed by 39 percent of overweight women. In contrast, only about a quarter of obese women and every fifth medically obese women experienced more than 2 point increase in their BMI status. Thus, a positive weight gain has become a serious problem at all BMI levels of women in general, and in normal and overweight categories in particular.

Sedentary lifestyle and change in mean BMI

Table 3 presents change in BMI status of women since the last four years (1999-2003) according to availability of a maid in the house and level of sedentary lifestyle. Considering the availability of a maid in the house, which indicates less or no physical activity of the women in the house, a significant differential has been found with the BMI status of women. Women who had a part-time maid in the house had experienced almost 3 point increase in their mean BMI, which increased to 6 points where a maid works full time, compared to only one and half point among women who did not have a maid. Also, remarkable differentials were noticed in women's mean BMI status according to their involvement in daily household chores, like sweeping and swabbing, cleaning of utensils,

cooking, washing clothes and watching TV. The complexity of these indicators is captured in a composite index of sedentary lifestyle and it was found that women with a medium level of sedentary lifestyle experienced a 2 points increase in their mean BMI, which increased to more than 3 points among women with a high level of sedentary lifestyle, compared to only 1.4 points among women with a low level of sedentary lifestyle. The above finding indicates that higher the level of sedentary lifestyle, higher was the increase in the mean BMI among women over the four-year period.

Dietary intake and change in mean BMI

Table 4 presents a change in the BMI status during last four years according to women's dietary intake. Dietary intake has been seen in terms of frequency of consuming milk or curd, fruits, non-vegetarian items, fried foods, sweets, soft drinks, ice creams and fast foods. A significant association has been found between consumption of milk or curd and a change in BMI status. Women who were consuming milk on a daily basis had experienced maximum increase in the level of BMI (2.4 points) than those who consumed milk less frequently. Frequency of fruit consumption also shows a positive association with an increase in the BMI status of women.

Consumption of non-vegetarian food items like chicken, meat or fish shows a mixed pattern of association with BMI. If consumption is more frequent like once a week, then increase in BMI level among women is found to be relatively high, whereas an increase in BMI level is found less among women who consume non-vegetarian items less frequently, like once in a month. Interestingly, increase in the BMI status of women is found to be higher among those who either do not consume non-vegetarian items at all or consume very occasionally. This may be due to the fact that those women may be consuming vegetarian fatty foods more frequently.

Daily consumption of fried foods has shown higher increase in the BMI status of women than women who eat fried foods less frequently. Again, consumption of sweets emerged as an important factor for increase in the BMI level of women. An almost 3 point increase in mean BMI has been observed among women who consumed sweets daily compared to less than 2 points among women who consumed sweets either once a month, occasionally or never. Further, consumption of junk food items like soft drinks and ice creams has also shown noteworthy differential in increase in the BMI level of women. A 2.7 points increase in the BMI level was observed among women who consumed soft drinks or ice cream on a daily basis compared to 1.5 points or less among women who consumed soft drinks or ice cream once a month or never. Women who visited restaurants for fast food consumption at least once in a month had experienced relatively higher increase in their BMI level than their counterparts.

Consumption of specific fatty/sugary items and increase in mean BMI

Table 5 presents the change in mean BMI status among women during the four years between the surveys according to the average consumption of specific fatty/sugary items such as, butter, milk, sugar, oil and *ghee*.

Butter is a direct source of fat and was found to be associated with increase in the BMI status of women. A 2.5 point increase in the mean BMI was observed among women who consumed butter compared to only 1.6 points among those who did not. Also milk is a rich source of fat and it is commonly consumed in India. A significant relationship has been found with the amount of milk consumption by women and increase in their BMI status. About 2.3 point increase in the mean BMI was observed among women who consumed more than 0.25 litre of milk per day compared to only 1.4 points among those who consumed less than that much quantity of milk per day.

On the other hand, monthly oil, ghee, or sugar consumption patterns have not shown any association with change in 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.

The above discussion indicates that an increase in BMI status is found to be more among women who frequently consumed junk foods or food items containing relatively more sugar and fats. A separate analysis for more than 2 point increase in the mean BMI during the four years also substantiates the role of junk foods and food items containing more sugar and fats in increasing BMI levels among women.

Determinants of change in BMI status

Table 6 presents both unadjusted and adjusted effects of sedentary lifestyle and dietary habits on more than 2 point change in the BMI status during 1999 and 2003 among women in Delhi in two separate models of logistic regression.

In the unadjusted model, women's level of sedentary lifestyle, education and BMI status in 1999 have shown a significant association with more than 2 point increase in the BMI level. Women with high level of sedentary lifestyle were found to be two-times more likely to experience more than 2 point increase in their BMI status with reference to women with a low level of sedentary lifestyle. Similarly, women with high school and above education were found to be 2.4-times more likely to experience more than 2 point increase in their BMI status with reference to illiterate women. However, women who were overweight or obese during 1999 were significantly less likely to experience more than 2 point increase in their BMI with reference to normal women, which shows that increase in BMI was more intensive among the normal women.

The adjusted model shows the effects of sedentary lifestyle, dietary habits, and socio-demographic characteristics of women on the likelihood of more than 2 point increase in BMI. In the adjusted model, only sedentary lifestyle was found to be statistically significant. Controlling for dietary habits and socio-demographic factors, the effect of sedentary lifestyle becomes stronger both in magnitude and in significance than in the unadjusted model. In the adjusted model, the odds ratio for women with high sedentary lifestyle was found to be 2.6-times higher ($p<0.001$) with reference to women with low sedentary lifestyle, compared to an odds ratio of 2.1 in the the unadjusted model ($p<0.005$). However, women's education which was significant in the unadjusted model was no longer significant in the adjusted model. The adjusted model confirms that the

level of sedentary lifestyle of women rather than dietary habits and socio demographic characteristics is the primary determinant of increase in BMI between the two surveys.

It is also noteworthy that women who were obese in 1999 were significantly less likely to have experienced more than 2 point increase in their BMI level with reference to normal BMI women. This again indicates that increase in BMI has been more intensive among the normal BMI women than among overweight or obese women.

Summary and conclusions

In the national capital territory of Delhi, India, a higher proportion of women had experienced a significant positive increase in their BMI levels in all three categories (normal, overweight and obese) during a four year period from 1999 to 2003. Even in this short period, an average, 2 point increase in mean BMI level was observed among women. Increasing weight gain is becoming a severe problem for all BMI levels of women in general, and among normal BMI women in particular. So, the problem of overweight and obesity needs to be considered very seriously as prevention is better than cure.

Previous studies have shown that obesity results from excess energy intake, inadequate physical activity, and sedentary lifestyle (Cannon *et al.* 2005; Wang 2004). 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. The logistic regression results confirm that sedentary lifestyle, rather than dietary habits and socio demographic characteristics of women, is the main predictor of increase in overweight and obesity among women. A significant increase in the BMI level was found among women who have a maid in their house and who are less involved in physical intensive household chores. Television watching 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.

Some limitations are inherent in this type of household surveys that involve reporting of past behaviours. These limitations should be taken into consideration when interpreting the findings of this study. A major limitation 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 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 socio-demographic 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.

Policy implications

Significant increase of obesity prevalence in almost all countries in the world recently has made obesity a global health problem. Obesity was labelled '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. Obesity is the epidemic of the affluents in India, and this association is consistent at both the individual and ecological levels (Subramanian & 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, especially those living in the national capital territory of Delhi. The present study has shown that unhealthy sedentary lifestyle has substantially widened among women in India which could turn the problem of obesity more severe in future. Therefore, the issue of obesity among women in India cannot be put on the back burner. So attention should be paid on overweight and obesity coexisting with undernutrition at the national level.

The issue of tackling obesity among women becomes more important because of the fact that a child learns his eating habits and lifestyle pattern from his mother first. A child imitates his mother as he spends most of his childhood days with his mother, though the influence of father cannot be ruled out. Therefore women must have a balanced dietary pattern and healthy lifestyle which she can instil in her children, which could help prevent the vicious cycle of intergenerational obesity. Efforts should be made to help Indian women to develop healthy lifestyle and adopt healthy dietary habits at an early age in a rational manner since childhood.

Considering the existing situation concerning the increasing prevalence of obesity among women in India at large, imperative public action is necessary. There is an urgent need to recognize the gravity of the problem of obesity and incorporate this issue in the general health system which is still not acknowledged. It is essential to develop anticipatory strategies which would have an impact on the whole society at large. Health service providers and the mass media can play a crucial role in modifying body weight among the inhabitants in the society. There should be public health surveillance and intervention programs to modify the risk factors of excessive weight and these should be implemented systematically at the regional as well as at the national level. Strategies for prevention and management of women's obesity should be in accordance with the existing and accessible public health policy.

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Fig. 1: Details of found and not found cases in the Follow-up Survey

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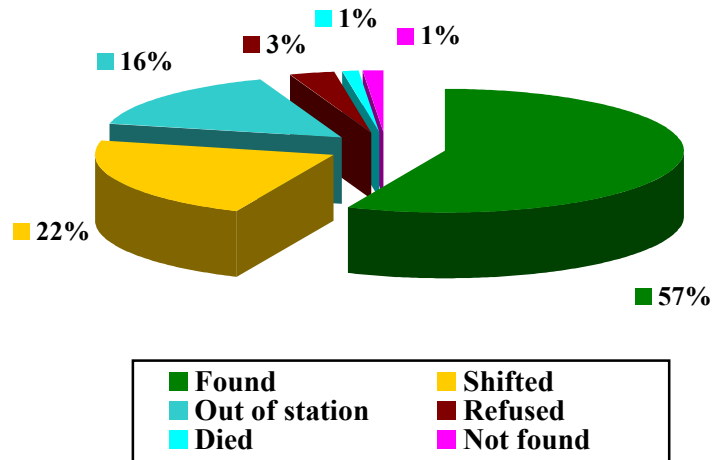
Table 1: Background characteristics of respondent who were sampled in NFHS-2, 1999, and in the follow-up survey, 2003

Background characteristics	NFHS-2, 1999 respondents[1]		Follow-up survey, 2003 respondents[2]	
	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				
Illiterate	25.4	462	20.3	66
Literate, <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	2.4	44	2.6	8
Ethnicity				
Scheduled caste/ tribes	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				
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**

[1] *Background characteristics of NFHS-2 Urban sample of Delhi corresponds to 1999 survey except for age*
[2] *Background characteristics for the follow–up survey respondents corresponds to 2003 survey*

Table 2: Absolute change in mean BMI and percentage of women experienced more than 2 point change in BMI during 1999 to 2003 by BMI status of women in 1999, Delhi, 2003

BMI Status in 1999	Mean BMI during 1999	Mean BMI during 2003	Change in Mean BMI	Percent experienced > 2 point change in BMI	No. of women
Normal	22.03	24.45	2.42	50.0	198
Overweight	27.27	28.81	1.54	38.5	91
Obese	31.86	32.96	1.11	25.9	26
Medically obese	39.18	38.20	-0.98	18.2	10
Total	**24.83**	**26.79**	**1.96**	**43.7**	**325**

Table 3: Absolute change in mean BMI and percentage of women who experienced more than 2 point change in BMI status during 1999 to 2003 according to availability of a maid in the house and level of sedentary lifestyle, Delhi, 2003

Performance of household chores	Change in mean BMI	Percent experienced > 2 point change in BMI	Number of women
Maid Availability**			
No maid	1.51	40.1	242
Part-time maid	2.91	52.7	74
Full-time maid	6.01	70.0	10
Sweeping and swabbing**			
Women only	1.40	36.3	136
Women with others	1.87	45.1	102
Others	2.93	53.4	88
Cleaning of utensils			
Women only	1.40	38.6	140
Women with others	1.90	44.1	102
Others	2.98	51.2	84
Cooking*			
Women only	1.71	39.3	197
Women with others	2.21	48.7	113
Others	3.44	62.5	15
Washing clothes			
Women only	1.75	41.2	170
Women with others	1.75	43.0	93
Others	2.85	52.4	63
Watching TV *			
Less than one hours	1.43	37.2	113
1-2 hours	2.10	43.9	138
More than 2 hours	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	**1.96**	**43.7**	**325**
Significance level by Chi-Sq. test: ** at 5% level; * at 10% level			

Table 4: Absolute change in mean BMI and percentage of women who experienced more than 2 point change in BMI status during 1999 to 2003 according to frequency of dietary intake, Delhi, 2003

Frequency of dietary intake	Change in mean BMI	Percent experienced > 2 point change in BMI	Number of women
Milk or curd**			
Daily	2.37	49.5	201
Once a week	1.40	33.3	69
Once a month	0.75	31.4	35
Occasionally or never	1.89	42.9	21
Fruits**			
Daily	2.44	51.8	164
Once a week	2.09	42.3	70
Once a month	1.43	37.3	51
Occasionally or never	0.47	22.5	41
Chicken, meat or fish**			
Once a week	2.24	47.9	48
Once a month	1.88	26.5	49
Occasionally or never	1.92	46.9	229
Fried foods			
Daily	2.13	35.3	17
Once a week	1.67	41.5	54
Once a month	2.00	44.0	159
Occasionally or never	2.04	46.3	95
Sweets			
Daily	2.75	52.6	19
Once a month	1.91	43.9	173
Occasionally or never	1.92	42.1	133
Soft drinks			
Daily	2.67	49.6	127
Once a month	1.67	40.4	89
Occasionally or never	1.38	39.4	109
Ice creams			
Daily	2.74	43.5	61
Once a month	2.20	49.1	105
Occasionally or never	1.51	40.3	159
Fast foods from restaurant			
At least in a month	2.74	46.7	45
Occasionally or never	1.84	43.2	280
Total	**1.96**	**43.7**	**325**

*Significance level by Chi-Sq. test: ** at 5% level; * at 10% level*

Table 5: Absolute change in mean BMI and percentage of women who experienced more than 2 point change in BMI status during 1999 to 2003 according to average consumption of specific fatty/sugary items, Delhi, 2003

Consumption of specific fatty/ sugary items	Change in mean BMI	Percent experienced > 2 point change in BMI	Number of women
Butter consumption			
No	1.64	41.4	198
Yes	2.47	47.2	128
Daily milk consumption			
Up to 0.25 litre	1.41	41.5	130
More than 0.25 litre	2.33	45.1	195
Monthly ghee consumption			
Up to 250 grams	2.01	43.7	183
More than 250 grams	1.91	44.1	143
Monthly oil consumption**			
Up to 500 grams	1.91	37.1	104
More than 500 grams	1.99	47.1	221
Monthly sugar consumption			
Less than one kg	2.00	44.0	141
More than one kg	1.93	43.5	185
Total	**1.96**	**43.7**	**325**
*Significance level by Chi-Sq. test: ** at 5% level; * at 10% level*			

Table 6: Logistic regression results showing the effect of sedentary lifestyle and dietary habits on more than 2 point change in the BMI status among women during 1999 to 2003, Delhi, 2003

Selected predictors	Unadjusted			Adjusted		
	Odds Ratio	95% CI		Odds Ratio	95% CI	
Level of sedentary lifestyle						
Low [R]						
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
Intake of sweets						
Once a week [R]						
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
Intake of soft drinks						
Once a week [R]						
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
Fast foods from restaurant						
At least in a month [R]						
Occasionally or never	0.85	0.46	1.60	1.30	0.61	2.78
Butter consumption						
Never consumes [R]						
Consumes	1.26	0.80	1.97	1.19	0.68	2.10
Daily milk consumption						
Less than 0.250 litre [R]						
More than 0.250 litre	1.18	0.75	1.84	1.06	0.57	1.97
Age						
20-29 [R]						
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]						
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]						
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						
Scheduled caste/ scheduled tribe [R]						
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]						
High	1.09	0.64	1.85	0.82	0.42	1.60
Working status						
Working [R]						
Non-working	1.69	0.78	3.66	1.44	0.60	3.46
BMI Status in 1999						
Normal [R]						
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
Constant	-			0.56		
Number of women	**325**			**325**		
*Significance level:***at 1% level, ** at 5% level, * at 10% level*						

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