# Role of Lifestyle and Diet in Emerging Obesity among Indian Women and its Impact upon their Health Status[♣]

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***Abstract***

*This paper examines the changes in BMI status of women according to lifestyle and dietary habits and impact of BMI on their health status by exploring the primary data collected from 329 women as a follow-up of NFHS-2 Delhi sample. Information on women's BMI, WHR, dietary habits, lifestyle, and health problems was collected. Findings suggest that women who are less involved in physical activities and frequently consumes more sugary and fatty items had experienced significant increase in BMI status, which was also confirmed in logistic regression results. Not only general and reproductive morbidities but perceived worst health status was also found significantly higher among obese women than overweight and normal women. Logistic regression also confirms that BMI and WHR are significant predictors in determining the morbidity condition. Therefore, there is an urgent need to recognize the gravity of this problem and incorporate obesity in the general health system.*

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## 1. Introduction

Obesity is defined as a condition in which excess body fat is accumulated. The practical and clinical definition of obesity is based on the Body Mass Index (BMI; weight (kg)/height ($m^2$). It is generally agreed that a BMI of greater than 30 is indicative of obesity, while a BMI of 25.0-29.9 is suggestive of overweight in an individual. BMI between 18.5-24.99 indicates normal BMI.

Obesity is increasing at an alarming rate throughout the world and has become a global 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). According to recent estimates, there are more than one billion overweight people worldwide, and some 250 million of these are estimated to be clinically obese (WHO, 1998a), equivalent to seven percent of the adult population. Existing WHO standards and data from 79 developing countries including a number of industrialized countries suggest that about 22 million children five years old are overweight worldwide (WHO, 1998b). 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 under nutrition, a significant proportion of overweight and

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[♣] *Paper for the Oral Presentation in the IUSSP XXV INTERNATIONAL POPULATION CONFERENCE Tours, France 18-23 July 2005.*

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obese people now coexist with those who are under nourished (Popkin, 2002). The National Family Health Survey (NFHS-2), 1998-99 shows six percent obesity with a BMI of 30 or more and 18 percent overweight with a BMI between 25-30 in urban India among women aged 15-49 years (IIPS and Macro, 2000). This epidemic has emerged almost unnoticed in our society.

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 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 and Popkin, 2002; Popkin, 2002, 2001, 1998; Popkin *et. al.,* 2001; Drewnowski and Popkin, 1997). Because of urbanization and modernization, our lives are becoming 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 and Ferre, 2003).

Obesity has serious long-term consequences. Obesity is not an immediately lethal disease itself, but has a significant risk factor associated with a range of serious non-communicable diseases and conditions (Tanaka and Nakanishi, 1996). Obesity is a first step, a gateway, to the chronic diseases. Hypertension, hyper cholesterolemia, heart disease, type 2 diabetes, gall bladder disease, asthma, mental health concerns (e.g., depression and low self esteem), and orthopedic disorders have all been linked to obesity (Mishra, 2004; American Academy of Pediatrics, 2003; WHO, 1998a; Saw and Rajan, 1997). Also, obesity or significant overweight can contribute to many problems in women's reproductive system like prolonged or heavy periods, menstrual pain, delayed ovulation, mid cycle spotting, short luteal phase, premenstrual spotting, premenstrual syndrome, infertility, amenorrhea, fibroids, tumors of uterus, breast cancer, endometrial cancer, ovarian cancer, uterine prolapse etc. (Shannon, 1993).

## 2. Review of Literatures

A number of factors have been linked to obesity, including age, gender and socio-economic status. Patterns of prevalence of overweight and obesity have emerged across

different socio-economic groups. In developed countries levels of obesity are higher in the lower socio-economic groups. In developing countries this relationship is reversed. Sobal and Stunkard (1989) after reviewing 144 published papers dealing with socio-economic status (SES) and obesity found that in developed societies there was an inverse relationship between SES and obesity among women, i.e., the poor were more likely to be obese. The relationship, however, was inconsistent among men and children of both sexes. A different situation was observed in developing societies (which included data from three native American populations – Apache, Kiowa/Comanche, and Navajo), where the relationship was direct, i.e., the wealthy were more likely to be obese. This applied to men, women and children. In India it has been found that women from lower socioeconomic groups are also significantly more likely to have a low BMI (Griffiths and Bentley, 2001).

Clear gender differences are seen in most countries with more women than men being obese (Ismail *et. al.,* 2002; Filozof *et. al.,* 2001; Mokhtar *et. al.,* 2001; James *et. al.,* 2000; Zargar *et. al.,* 2000; Kadyrova and Salkhanov, 1990). In contrast, the proportion of men who are overweight tends to be greater than women. Research on obesity in India has found prevalence to be higher among women (Misra *et. al.,* 2001; Gopinath *et. al.,* 1994), and among economically better off persons (Griffiths and Bentley, 2001; Singh *et. al.,* 2000; Dhurandhar and Kulkarni, 1992). Higher socio-economic status has been consistently associated with greater risk of obesity and diabetes, but the relationship with educational status appears to be inconsistent (Gupta, 1994; al-Mannai *et. al.,* 1996). In a study of obesity among north Indian women it was found that women working as professional/technical/managers were more prone to be overweight and obese than those working in other fields (Agrawal, 2002). Age wise, a significant increase has also been noticed for obesity. In developed countries it has been found that there occurs an increase in the body weight with ageing, at least up to 50-60 years old (both in men and women). The relationship between obesity and age is similar in developing countries, but the maximum rates of obesity tend to be reached at an earlier age (e.g. 40 years old). The decline in prevalence after this peak is thought to be partly attributed to lower survival rates of obese individuals. In India, it has been found that older women were relatively more overweight and obese than younger women (Agrawal, 2002; Dhurandhar and Kulkarni, 1992). In a study among urban women in Mexico City (Arroyo *et. al.,* 1995) it was found that parity and age increased the risk of being overweight at the low and middle socio-economic levels.

In a recent study among women in northern India by Agrawal and Mishra (2004), it was found that urban residence significantly increases the risk of obesity (RR=1.57; 95%CI: 1.06, 2.32). 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 (Sobngwi *et. al.,* 2002; al-Mannai *et. al.,* 1996; Popkin *et. al.,* 1994; Kadyrova and Salkhanov, 1990). Decreased physical activity has been observed in urban compared with rural groups in Kiribati (King *et. al.,* 1984), Samoa (Hodge *et. al.,* 1994) and Fiji (Zimmet *et. al.,* 1983). Family history of obesity, childbearing, and a sedentary lifestyle

have also been linked to obesity (Griffiths and Bentley, 2001; Tiwari, *et. al*, 1998; Dhurandhar and Kulkarni, 1992). Also, it was found that migration to urban centres was significantly associated with a greater waist hip ratio in severely stunted females (Schroeder *et. al.,* 1999).

Food habits are the way in which individuals or groups of person responses 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 and Marie, 1997).

The growing popularity of fast food is just one of many cultural changes that have been brought about by globalisation (Schlosser, 2002). Income is a major factor influencing food habits and nutrition. With a significant increase in income, more expensive foods are purchased and eaten. (den Hartog and van Staveren, 1983). Despite insufficient employment, overcrowding, inadequate cooking facilities and expensive housing, many comparisons with country folk show that townsfolk have more varied food, including fruits and vegetables, more meat less seasonal influence on diet (de Garine, 1969. However, this general impression is subjective, as the situation may differ from country to country, and between socio-economic groups in one town.

Differences in the predominant lifestyles and developmental status of nations and regions also influence weight patterns (VanItallie, 1994). In an American study, Gortmaker *et. al.,* in 1996 found that much of the increase in obesity among both male and female adolescents is related to inactivity, with television viewing being one factor that has been shown to be positively correlated to excess weight gain. A study by Saw and Rajan (1997), and another study by Vioque *et. al.*, (2000) contributed the rising trend of obesity to such factors as low levels of physical activity, high calorie intake and long hours of watching television.

A beneficial effect of physical activity on obesity has been demonstrated in many studies. A study performed on 3,132 individuals at seven health centres delineated the association between exercise and obesity among the Japanese. This study showed that the prevalence of obesity was lower among individuals who were in the habit of performing exercise, and the risk of obesity in this group was low (OR-0.48) (Hiraoka *et. al.,* 1998). Many studies have shown that the prevalence of obesity, the mean BMI, or the body weight decreases as the amount of exercise increases (Williamson, 1996; French *et. al.,* 1994; Williamson *et. al.,* 1993). The risk of weight gain was decreased by jogging (OR-0.57 in men) and aerobics (OR-0.59) (Kahn *et. al.,* 1997; Wilmore, 1996; Williamson *et. al.,* 1993).

The transition from the traditional way of life to one that is characterized by easy access to calorie dense food and a sedentary lifestyle has led to a rapid increase in the prevalence of obesity, followed by the appearance of other 'diseases of affluence' such as diabetes and cardiovascular diseases (Fall, 2001; O'Dea, 1992). The importance of obesity as a risk factor for a number of diseases including type 2 diabetes, cardiovascular disease, hypertension, gallstones and certain cancers, is well documented (WHO, 1998a). The risk of developing diabetes increases as the degree of overweight increases. The prevalence of diabetes is approximately three times higher in overweight than in non-overweight persons. Cohort and cross-sectional studies have indicated that obesity may be linked with an increased risk of coronary heart disease, hypertension, diabetes mellitus and gallstone (Saw and Rajan, 1997). Obesity leads to adverse effects on health as a result of associated co-morbidities such as coronary heart disease (CHD), non-insulin diabetes dependant mellitus (NIDDM), certain cancers, gall bladder diseases, osteo-arthritis, etc (Shetty, 2000). It is estimated that 90 percent of those with NIDDM in the US are obese.

Elevated risk of back pain has been observed in relation to obesity, particularly among women (Han *et. al.,* 1997; Garzillo and Garzillo, 1994). The risk of back pain may lead to a reduction in the physical activity level and hence an increase in adiposity. Alternatively, obesity may increase the mechanical load on the spine, thereby increasing the risk for back pain. The extra weight an obese person carries, especially fat distribution in the central portion, puts increased stress on the weight-bearing joints, particularly the knees, hips and some joints of the back. Persons with a BMI of at least 30 have a markedly increased risk for knee osteoarthritis compared with those with more modest overweight (BMI=25.0-29.9).

Gallbladder disease is the most common form of digestive diseases among the obese. The risk for gallstones and cholecystectomy increases with increasing body weight. The increased cholesterol levels excreted in the bile as obesity develops appear to be linked to the development of gallstones (Stampfer *et. al.,* 1992). Gallstones occur three or four times more often in the obese than in the general population.

Several studies in India have related overweight conditions with diabetes, hypertension, and heart disease (Venkatramana and Reddy, 2002; Misra *et. al.,* 2001; Singh *et. al.,* 2000; Gopinath *et. al.,* 1994). Obesity is thus an important factor in increasing morbidity and mortality patterns due to chronic non-communicable diseases.

Obesity increases the risk of several reproductive disorders, negatively affecting normal natural function and fertility (American Obesity Association). Obesity is related to several gynaecological disorders including polycystic ovary syndrome (PCOS) (Pettigrew and Hamilton-Fairley, 1997; Yen, 1980), infertility (Pettigrew and Hamilton-Fairley, 1997; Zaadstra *et. al.,* 1993) and general menstrual disorders (Lake *et. al.,* 1997; Rich-Edwards *et. al.,* 1994; Hartz *et. al.,* 1979). One of the first attempts to systematically document the relationship between obesity and menstrual dysfunction was made by Rogers and Mitchell in 1952. They found a much higher incidence of obesity in amenorrheic women (45 percent) than they did in two populations of normal cycling control subjects (13 percent and 9 percent). It has also been suggested that abdominal obesity may be a particularly important risk factor for menstrual disorders (Hartz *et. al.,*

1984) and infertility (Zaadstra *et. al.,* 1993), in that such localised fatness may increase androgenicity (Seidell *et. al.,* 1990). In a study by Carolus, *et. al.* (1995), the prevalence of overweight and obesity was alarmingly high among infertile Saudi females. Out of the 1,755 infertile patients, only 17 percent were in the normal weight category, 42 percent were overweight and 38 percent were obese, while the remaining three percent were underweight. Hamilton-Fairley *et. al.,* in 1992 found significantly higher abortion rates in moderately obese females than in females of normal weight.

Weight loss may be particularly beneficial for obese women with PCOS, in that it improves the associated hormonal and menstrual abnormalities (Kiddy *et. al.,* 1992). The adverse health implications of obesity are significant and, accordingly, all obese patients, regardless of their menstrual function and fertility, should be encouraged to participate in some form of structured weight control programme (Simopoulos, 1958). In one sense, a fertile obese patient may be a greater problem to the obstetrician/gynaecologist for, if she achieves pregnancy, she has an increased risk of developing a variety of medical and surgical complications (Pasukala *et. al.,* 1986; Kleiginan and Gross, 1985).

## 3. Need and importance of the study

The WHO recently stated that "the growth in the number of severely overweight adults is expected to be double than under-weight during 1995-2025" (WHO, 1998b). Also, numerous studies have corroborated the relationship between weight gain (BMI of at least 30) and increased risk of death. A study by Garrow (2000) showed that the mortality ratio increases drastically at higher BMI from the minimum 100 among those with a BMI 20-25 $kg/m^2$ to more than 150 crossing BMI of 35 $kg/m^2$ and further increases to more than 200 and 300 at the BMI of 40 $kg/m^2$ and 45 $kg/m^2$, respectively.

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. There is much scope for increasing urbanization and concentration of population in larger cities. Again, globalisation is also playing an important role in modernization and sedentary lifestyle. Globalisation has made cheap vegetable oils and fats widely available, greatly increasing fat consumption in all nations (Drewnowski and Popkin, 1997). So, in the near future, obesity is likely to emerge as a challenging problem for India. Though the pattern 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. Therefore, there is a need to sensitize the public and policy makers about the problem of obesity looking large in India in future, as *prevention is better than cure.*

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 the causes and consequences of this rapidly growing public health threat remains poor. Therefore, this study is an attempt to understand the dynamics of obesity among women in the Indian scenario.

## 4. Objectives of the study

1. To examine the changes in the status of body mass index among women according to lifestyle and dietary habits in Delhi.

2. To investigate the health status of women (different morbidity conditions, with special focus on reproductive health) according to their BMI status.

## 5. Data and Methods

The study has been carried out with primary data based on the follow-up survey of NFHS-2 samples of Delhi. NFHS-2 collected demographic, socio-economic, and health information from a nationally representative sample of 90,303 ever-married women age 15–49 years residing in 92,486 households. All states of India are represented in the sample (except 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 report, India (IIPS and ORC Macro, 2000).

NFHS-2 also gives important information about the weight and height of eligible women[1]. In NFHS-2, each ever-married woman age 15-49 years 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. The weight and height data have been used to calculate the body mass index (BMI).

Primary data was collected during May-July 2003 in a follow-up survey of a subgroup of ever-married women age 15-49 years in the state of Delhi. The selection of sample for the follow-up survey has been done according to the degree of body mass index (BMI) of women. The follow-up survey was conducted with the help of household addresses from the *Household Questionnaire* of NFHS-2. A sub-sample of women, who were interviewed in NFHS-2, have been resurveyed in the present study to measure their weight (with the same machine used in NFHS-2) and height to compute the present BMI. In the follow-up survey, circumference of waist and hip of woman was also measured to compute waist hip ratio (WHR), which was not done in NFHS-2. In addition to these measurements, detailed information has been collected on their dietary habits, lifestyle, and health problems with special focus on maternal and reproductive health.

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

In the present study BMI is used as main indicator of the degree of overweight and obesity among women. However, waist hip ratio (WHR) has also been analysed along with BMI in the study to understand the condition of central obesity. Women with more than 0.85 WHR are considered to be obese.

Bivariate as well as multivariate techniques have been used for data analysis. Cross tabulation has been done in each of the three categories with different dependent variables. In the multivariate analysis, a binary logistic regression model has been used. Apart from this, the chi square technique has been applied wherever necessary to explore significant differentials. Women who were pregnant at the time of the survey or women who had given birth during the two months preceding the survey have been excluded from the analysis. While analysing the data, appropriate sample weight has been applied to the follow up data with proportion to the NFHS-2 sample

## 6. Summary and Results

### 6.1 Overall change in the status of BMI

Table 1 presents the change in the BMI status during last four years among women in Delhi and a significant change has been found. Among the women with normal BMI status at the time of NFHS-2 survey, 31 percent became overweight and seven percent became obese and further one percent changed into medically obese during the last four years. However, only one percent normal women experienced a negative change in their BMI status, i.e. they had become underweight and the remaining 60 percent of normal women had managed to maintain their normal status.

Considering overweight women, 25 percent had become obese and four percent became medically obese in the last four years. However, only eight percent overweight women experienced a negative change towards normal and further one percent to underweight. The remaining 62 percent overweight women maintained their status. This shows that a higher proportion of overweight women (about 30 percent) experienced further increase in their weight rather than a decrease (9 percent).

**Table 1: Percent change (from 1999 to 2003) in the status of BMI among women, Delhi, 2003**

| BMI Status in 1999 | BMI Status in 2003 | | | | | | |
|---|---|---|---|---|---|---|---|
| | Under weight | Normal | Over weight | Obese | Medically obese | Total Percent | No. of women |
| Normal*** | 1.0 | 60.1 | 31.3 | 6.6 | 1.0 | 100.0 | 198 |
| Overweight*** | 1.1 | 7.9 | 61.8 | 24.7 | 4.5 | 100.0 | 89 |
| Obese*** | 0.0 | 0.0 | 7.7 | 73.1 | 19.2 | 100.0 | 26 |
| Medically obese*** | 0.0 | 0.0 | 0.0 | 20.0 | 80.0 | 100.0 | 10 |
| **Total** | **0.9** | **39.0** | **36.8** | **17.3** | **5.9** | **100.0** | **-** |
| **No. of women** | **3** | **126** | **119** | **56** | **19** | **-** | **323** |

Significance level by Chi-Sq. test: *** at 1% level

Considering the obese women, 19 percent became medically obese in the last four years whereas eight percent experienced a negative change towards overweight. However, no one became normal from the obese category. In this category also, the positive change is significantly higher than the negative change.

Thus, the change in the BMI status during the last four years shows a highly significant positive increase in all the three categories (normal, overweight and obese). Almost 40 percent of the normal women had experienced a positive change in their BMI level, followed by 29 percent of overweight women and 20 percent of obese women. In contrast, only one percent of normal women, nine percent of overweight women and eight percent of obese women experienced a negative change in their BMI status. Thus, positive weight gain is becoming a serious problem at all BMI levels of women in general, and in normal and overweight categories in particular. So, this problem need to be considered very seriously as prevention is better than cure.

### 6.1.1 Women's' involvement in daily chores and change in BMI status

Table 2 presents percentage change in BMI status of women since the last four years (1999-2003) according to availability of a maid in the house and women's involvement in daily chores. Considering the availability of a maid in the house, which to some extent shows low or no physical activity of the women in the house, a significant relationship has been found with the BMI status of women. Women who had a part-time maid in the house had experienced significantly higher increase (47 percent) in their BMI status compared to women who were not having a maid (27 percent). Further, about 77 percent women had an experienced increase in their BMI status where a maid works full time.
Significant differentials are noticed in the women's BMI status according to their involvement in daily household chores like sweeping and swabbing, cleaning of utensils, cooking, washing clothes and other household chores. About 25 percent women who do sweeping and swabbing by themselves had experienced an increase in BMI status compared to 31 percent of women who do these works partially and 48 percent women who did not do sweeping and swabbing at all. An almost similar pattern has been noticed for the increase in BMI level of women with their involvement in household chores such as cleaning utensils, washing clothes, cooking etc.

The above finding suggests that women who are less involved in labour intensive household chores had experienced a significant increase in their BMI status indicating that a more sedentary lifestyle and less physical activity leads to an increase in the BMI status over a period of time.

**Table 2: Percent change (from 1999 to 2003) in the BMI status among women according to availability of a maid in the house and women's involvement in daily chores, Delhi, 2003**

| Performance of household works | No change | Increase | Decrease | Number |
|---|---|---|---|---|
| **Maid Availability*** ** | | | | |
| No maid | 67.7 | 27.2 | 5.1 | 232 |
| Part-time maid | 49.3 | 46.7 | 4.0 | 75 |
| Full-time maid | 27.3 | 72.7 | 0.0 | 11 |
| **Sweeping and swabbing*** ** | | | | |
| Women only | 72.6 | 25.2 | 2.2 | 135 |
| Women with others | 59.8 | 31.4 | 8.8 | 102 |
| Others | 47.2 | 48.3 | 4.5 | 89 |
| **Cleaning of utensils*** ** | | | | |
| Women only | 70.5 | 27.3 | 2.0 | 139 |
| Women with others | 61.2 | 30.1 | 8.7 | 103 |
| Others | 47.6 | 47.6 | 4.8 | 84 |
| **Cooking** | | | | |
| Women only | 66.5 | 29.9 | 3.6 | 197 |
| Women with others | 56.6 | 37.2 | 6.2 | 113 |
| Others | 40.0 | 53.3 | 6.7 | 15 |
| **Washing clothes** ** | | | | |
| Women only | 68.0 | 29.0 | 3.0 | 169 |
| Women with others | 61.3 | 31.2 | 7.5 | 93 |
| Others | 47.6 | 47.6 | 4.8 | 63 |
| **Other household chores** | | | | |
| Women only | 65.8 | 31.1 | 3.1 | 193 |
| Women with others | 58.8 | 34.3 | 6.9 | 102 |
| Others | 46.7 | 46.7 | 6.7 | 30 |
| **All the above five works*** | | | | |
| Women only | 71.7 | 26.0 | 2.4 | 127 |
| Women with others | 58.4 | 35.1 | 6.5 | 154 |
| Others | 44.4 | 50.0 | 5.6 | 18 |
| **Total percent** | **62.0** | **33.4** | **4.6** | **-** |
| **Number of women** | **202** | **109** | **15** | **326** |

Significance level by Chi-Sq. test: *** at 1% level; ** at 5% level; * at 10% level

### 6.1.2 Dietary habits and change in BMI status

Table 3 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, pulses or beans, vegetables, fruits, non-vegetarian items, fried foods, sweets, cold drinks, ice creams, fast foods and also fasting pattern. A significant relationship 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 whereas less increase in the level of BMI was found where frequency of consumption of milk was less. However, consumption of green leafy vegetables shows that increase in BMI was comparatively less for women (32 percent) who consume it daily compared to 43 percent of women who consumes at least once a week. This may be because of the fact that instead of consuming green leafy vegetables daily these women might be taking less fibrous items and more fatty foods. 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 with an increase in BMI level of women. If consumption is more frequent like once a week, then increase in BMI level among women is found to be relatively higher, whereas an increase in BMI level is found less among women who consume non-vegetarian items less frequently, like once a month. Interestingly, increase in the BMI status of women is found to be high 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 shows higher increase in the BMI level of women (41 percent) compared to a relatively less increase among women who eat fried foods less frequently. Again, consumption of sweets comes out as an important factor for an increase in the BMI level of women. About 48 percent women who consume sweets daily experienced an increase in BMI level compared to about 31 to 33 percent of women who consume sweets either once a month or occasionally or never. However, consumption of junk food items like cold drinks and ice creams shows a little differential in the increase in the level of BMI of women. More than 36 percent of women who were consuming ice cream daily experienced an increase in their BMI level compared to about 30 percent women consuming ice cream once a month or never.

Other attributes related to non-consumption of food like fasting, is also found to be associated with an increase in the BMI level. Contrary to expectation, women who were fasting experienced a relatively more increase in the BMI status (36 percent) compared to women who were not keeping fast (29 percent). Similarly, women who were fasting at least once a month experienced a relatively more increase in their BMI status (43 percent) compared to women who were fasting occasionally (about 33 percent).

Again, it is difficult to comment whether it is the type of food that is consumed during fast or the effect of fasting that is responsible. It is also possible that women experiencing more increase in their BMI level are fasting frequently as a preventive measure.

Thus, the above discussion confirms that an increase in BMI status is found to be more among women who frequently consumed the food items containing relatively more sugar and fats. Also ingredients of balanced diet like green leafy vegetables are found to be less consumed by women who experienced relatively more increase in BMI status.

**Table 3: Percent change (from 1999 to 2003) in the BMI status among women according to frequency of women's dietary intake, Delhi, 2003**

| Frequency of dietary intake | No change | Increase | Decrease | No. of women |
|---|---|---|---|---|
| **Milk of curd*** ** | | | | |
| Daily | 54.7 | 41.8 | 3.5 | 201 |
| Once a week | 79.4 | 16.2 | 4.4 | 68 |
| Once a month | 79.4 | 17.6 | 29.9 | 34 |
| Occasionally or never | 52.6 | 26.3 | 21.1 | 19 |
| **Pulses or beans*** ** | | | | |
| Daily | 61.6 | 33.5 | 4.9 | 263 |
| Once a week | 64.9 | 33.3 | 1.8 | 57 |
| Occasionally or never | | | | |
| **Green leafy vegetables** | | | | |
| Daily | 64.1 | 32.0 | 3.9 | 281 |
| Once a week | 47.5 | 42.5 | 10.0 | 40 |
| Occasionally or never | - | - | - | 3 |
| **Other vegetables** | | | | |
| Daily | 60.9 | 34.1 | 5.0 | 258 |
| Once a week | 66.2 | 29.2 | 4.6 | 65 |
| **Fruits** ** | | | | |
| Daily | 56.4 | 40.5 | 3.1 | 163 |
| Once a week | 64.3 | 32.9 | 2.9 | 70 |
| Once a month | 70.6 | 21.6 | 7.8 | 51 |
| Occasionally or never | 71.8 | 17.9 | 10.3 | 39 |
| **Eggs** | | | | |
| Once a week | 65.1 | 30.2 | 4.7 | 43 |
| Once a month | 69.0 | 23.8 | 7.1 | 42 |
| Occasionally or never | 60.5 | 35.3 | 4.2 | 238 |
| **Chicken, meat or fish** | | | | |
| Once a week | 56.3 | 37.5 | 6.3 | 48 |
| Once a month | 77.6 | 16.3 | 6.1 | 49 |
| Occasionally or never | 59.9 | 35.7 | 4.4 | 227 |
| **Fried foods** | | | | |
| Daily | 52.9 | 41.2 | 5.9 | 17 |
| Once a week | 69.8 | 28.5 | 1.9 | 53 |
| Once a month | 64.2 | 30.8 | 5.0 | 159 |
| Occasionally or never | 57.0 | 37.6 | 5.4 | 93 |
| **Sweets** | | | | |
| Daily | 52.6 | 47.4 | 0.0 | 19 |
| Once a month | 63.2 | 31.0 | 5.7 | 174 |
| Occasionally or never | 62.1 | 33.3 | 4.5 | 132 |
| **Cold drinks** | | | | |
| Daily | 60.9 | 35.2 | 3.9 | 128 |
| Once a month | 63.3 | 31.1 | 5.6 | 90 |
| Occasionally or never | 61.7 | 32.7 | 5.6 | 107 |
| **Ice creams** | | | | |
| Daily | 59.0 | 36.1 | 4.9 | 61 |
| Once a month | 64.8 | 32.4 | 2.9 | 105 |
| Occasionally or never | 61.8 | 31.8 | 6.4 | 157 |
| **Fast foods** | | | | |
| Daily | 66.7 | 33.0 | 0.0 | 18 |
| Once a month | 53.6 | 42.9 | 3.6 | 28 |
| Occasionally or never | 62.7 | 31.9 | 5.4 | 279 |
| **Keep fast** | | | | |
| Yes | 58.9 | 36.2 | 4.9 | 185 |
| No | 67.2 | 28.5 | 4.4 | 137 |
| **Frequency of keeping fast** | | | | |
| At least once a month | 52.8 | 43.4 | 3.8 | 53 |
| Occasionally | 61.9 | 32.8 | 5.2 | 134 |
| **Total percent** | **62.0** | **33.4** | **4.6** | **-** |
| **Number of women** | **202** | **109** | **15** | **326** |

Significance levels by Chi-Sq. test: *** at 1% level; ** at 5% level

### 6.1.3 Consumption of specific fatty items and change in BMI status

Consumption of specific fatty items may be associated with the increase in BMI status of women. An attempt has also been made to see the relationship between specific fatty items and change in the BMI status. Table 4 presents the change in BMI status among women in the last four years according to the average consumption of specific fatty items like, oil, *ghee*, butter, sugar and milk.

A positive association between the amount of consumption of the specific fatty items and an increase in the level of BMI was found. About 21 percent increase in the BMI status has been found among women consuming less than 500 grams of oil per month compared to 37 percent among women consuming between 500 grams to one kg of oil per month. Similarly, 29 percent of women who do not consume *ghee* had experienced increase in their BMI status compared to 35 percent women who consumed either 250 grams of *ghee* per month or more. Consumption of butter also determines an increase in the BMI status of women. About 43 percent women consuming butter experienced an increase in their BMI level compared to 27 percent women who were not consuming butter. Consumption of sugar indicates the indirect source of fat, as excess of sugar in the body converts into fat. A significant relationship has been found between sugar consumption and an increase in the BMI status. Higher the consumption of sugar, higher was the increase in the level of BMI of women. About 30 percent of women consuming less than one kg of sugar per month had experienced increase in their BMI status compared to 36 percent women consuming more than one kg of sugar per month.

**Table 4: Percent change (from 1999 to 2003) in the BMI status among women according to women's average consumption of specific fatty items, Delhi, 2003**

| Consumption of specific fatty items | No change | Increase | Decrease | Number |
|---|---|---|---|---|
| **Monthly oil consumption** | 71.4 | 20.6 | 7.9 | 63 |
| Up to 500 grams | 59.5 | 37.1 | 3.3 | 210 |
| More than 500 grams | 57.8 | 33.3 | 8.9 | 45 |
| **Monthly ghee consumption** | | | | |
| Not consuming | 66.1 | 29.0 | 4.8 | 62 |
| Up to 250 grams | 59.6 | 34.9 | 5.5 | 109 |
| More than 250 grams | 62.0 | 34.5 | 3.5 | 142 |
| **Butter consumption*** ** | | | | |
| Never consumes | 68.0 | 26.9 | 5.1 | 197 |
| Consumes | 52.8 | 43.3 | 3.9 | 127 |
| **Monthly sugar consumption** | | | | |
| Less than one kg | 65.7 | 29.9 | 4.4 | 137 |
| More than one kg | 59.5 | 35.7 | 4.9 | 185 |
| **Daily milk consumption*** ** | | | | |
| Up to 0.25 liter | 74.8 | 19.7 | 5.5 | 127 |
| More than 0.25 liter | 54.4 | 41.5 | 4.1 | 195 |
| **Total percent** | **62.0** | **33.4** | **4.6** | **-** |
| **Number of women** | **202** | **109** | **15** | **326** |

Significance level by Chi-Sq. test: *** at 1% level

Milk is also an indirect source of fat. A highly significant relationship has been found with the amount of milk consumption and an increase in the BMI status of women. About 20 percent of women consuming up to 0.25 liter of milk per day had experienced an increase in their BMI compared to 42 percent of women consuming more than 0.25 liter of milk per day. Thus, the above discussion shows a clear relationship between the amount and types of items consumed and an increase in the BMI status of women.

### 6.1.4 Determinants of positive change in BMI status

In order to examine the determinants of positive change in BMI status among women, logistic regression analyses have been adopted. In the following section, the effect of physical activities and dietary habits on change in BMI status has been examined after controlling for other factors. Table 5 presents logistic regression results for a positive change in BMI status of women showing odds ratio for physical activity, diet and other background factors in five different models.

Model I shows unadjusted effects of sweeping and swabbing (which refers to physical activity of women) on overweight or obesity. It shows significantly higher (about 3 times) likelihood of experiencing positive change in BMI status among women who were not sweeping and swabbing with reference to women who do these activities by themselves.

Model II shows the effect of dietary behaviour without controlling for background factors as well as physical activity on positive change in BMI status of women. Eating outside and consumption of more milk has come out as significant factors. Women not eating outside are almost half less likely to experience positive change in BMI status with reference to women eating outside. However, women consuming more than 0.25 liter of milk were two and a half times more likely to experience positive change in BMI with reference to women consuming less than 0.25 liter of milk.

In Model III, effects of physical activity as well as dietary behaviour in experiencing a positive change in BMI status of women have been seen without controlling the background factors. Still, physical activity and milk consumption have come out as significant factors. The effect of sweeping and swabbing was found relatively less in experiencing positive change in BMI status of women after controlling the dietary pattern, as the odds ratio was 1.9 for not sweeping or swabbing compared to the odds ratio of three without controlling the dietary pattern in Model I. However, consumption of milk shows a similar pattern like the previous model.

Model IV shows the effect of socio-economic factors on positive change in BMI status of women without controlling physical activity and dietary factors. Only educational background of women is found as a significant factor. The likelihood of positive change in BMI status of women with education high school and above is about two and a half times higher with reference to illiterate women.

**Table 5: Logistic regression results for positive change in the BMI status among women aged 20-53 years according to some selected factors, Delhi, 2003**

| Selected predictors | Model-I | Model-II | Model-III | Model-IV | Model-V |
|---|---|---|---|---|---|
| | Exp (β) | Exp (β) | Exp (β) | Exp (β) | Exp (β) |
| **Sweeping and swabbing** | | | | | |
| Respondent only [R] | 1.000 | | 1.000 | | 1.000 |
| Respondent with others | 1.484 | - | 1.833* | - | 1.739 |
| Others | 2.942*** | - | 1.872* | - | 2.154* |
| **Eating outside the home** | | | | | |
| Yes [R] | - | 1.000 | | - | 1.000 |
| No | - | 0.599* | 0.675 | - | 0.646 |
| **Intake of fried foods** | | | | | |
| Daily [R] | | 1.000 | 1.000 | | 1.000 |
| Once a week | - | 0.644 | 0.725 | - | 0.743 |
| Once a month | - | 0.962 | 1.004 | - | 1.120 |
| Occasionally or never | - | 1.242 | 1.329 | - | 1.474 |
| **Intake of sweets** | | | | | |
| Once a week [R] | | 1.000 | 1.000 | | 1.000 |
| Once a month | - | 0.593 | 0.542 | - | 0.637 |
| Occasionally or never | - | 0.607 | 0.517 | - | 0.525 |
| **Intake of cold drinks** | | | | | |
| Once a week [R] | | 1.000 | 1.000 | | 1.000 |
| Once a month | - | 1.251 | 1.375 | - | 1.258 |
| Occasionally or never | - | 0.911 | 0.982 | - | 0.973 |
| **Intake of ice cream** | | | | | |
| Once a week [R] | | 1.000 | 1.000 | | 1.000 |
| Once a month | - | 1.215 | 1.172 | - | 0.942 |
| Occasionally or never | - | 1.425 | 1.451 | - | 1.363 |
| **Butter consumption** | | | | | |
| Never consumes [R] | - | 1.000 | 1.000 | - | 1.000 |
| Consumes | - | 1.491 | 1.545 | - | 1.476 |
| **Daily milk consumption** | | | | | |
| Less than 0.250 litre [R] | | 1.000 | 1.000 | | 1.000 |
| More than 0.250 litre | - | 2.454*** | 2.385*** | - | 2.465** |
| **Monthly sugar consumption** | | | | | |
| Less than one kg [R] | | 1.000 | 1.000 | | 1.000 |
| More than one kg | - | 1.114 | 1.124 | - | 1.124 |
| **Age** | | | | | |
| 20-29 [R] | | | | 1.000 | 1.000 |
| 30-39 | - | - | - | 1.286 | 1.377 |
| 40-54 | - | - | - | 1.947 | 0.798 |
| **Education** | | | | | |
| Illiterate [R] | | | | 1.000 | 1.000 |
| Literate, <middle school complete | - | - | - | 1.884 | 2.068 |
| Middle school complete | - | - | - | 1.466 | 1.843 |
| High school complete and above | - | - | - | 2.591** | 1.635 |

| | | | | | |
|---|---|---|---|---|---|
| **Religion** | | | | | |
| Hindu [R] | | | | 1.000 | 1.000 |
| Muslim | - | - | - | 0.617 | 0.949 |
| Others | - | - | - | 1.111 | 1.013 |
| **Caste/tribes** | | | | | |
| Scheduled caste/ scheduled tribe [R] | | | | 1.000 | 1.000 |
| Other backward class | - | - | - | 2.024 | 1.919 |
| Others | - | - | - | 1.734 | 1.172 |
| **Standard of living index** | | | | | |
| Low/ Medium [R] | | | | 1.000 | 1.000 |
| High | - | - | - | 1.332 | 0.939 |
| **Working status** | | | | | |
| Working [R] | | | | 1.000 | 1.000 |
| Non-working | - | - | - | 0.638 | 0.524 |
| Constant | **0.348** | **0.414** | **0.268** | **0.141** | **0.151** |
| -2 Log likelihood | **387.6** | **367.8** | **362.6** | **372.6** | **343.2** |
| $R^2$ | **0.060** | **0.124** | **0.145** | **0.090** | **0.192** |
| Number of women | **302** | **299** | **299** | **294** | **291** |

- Not included in the models;
[R] Reference category;
Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01

The final model (Model V) shows the effect of all the above factors such as physical activity, dietary behaviour, and background characteristics on positive change in BMI status of women after controlling for each other. In the full Model, only physical activity and milk consumption are found as statistically significant factors. Controlling for dietary as well background factors, the effect of physical activity has reduced than in unadjusted model. The odds ratio for women not sweeping and swapping is found to be nearly two times higher with reference to women sweeping and swabbing, which was almost three in the unadjusted model. Thus, the different models in Table 5.7 confirm that physical activity and dietary habit rather than background characteristics of women are the most significant factors in the positive change in the BMI status of women.

## 6.2 General health status

General health status has been seen in terms of perceived health status and specific morbidity conditions among women according to different levels of BMI.

### 6.2.1 Perceived health status

Table 6 presents the perceived health status and morbidity condition of women according to different levels of BMI, since one year prior to the survey and the year before. A question was asked to the women, *"How would you describe your general health in comparison to other women of your age? Would you say it is same as other women, better than other women, poorer than other women or is it worst than other women"*? This perceived health status of the women was asked for the last year (a year before the date of interview) and one year before that. It is found that a significantly higher

proportion of obese and overweight women reported poorer and worst condition of their health than women with a normal BMI. Forty-eight percent of obese women and 32 percent of overweight women reported poorer health status before last year compared to 25 percent of women with a normal BMI. A significant increase has been found in the proportion of women reporting poorer health status since last year than before. Almost half the obese women and 37 percent overweight women reported poorer health status compared to 33 percent of the women with a normal BMI.

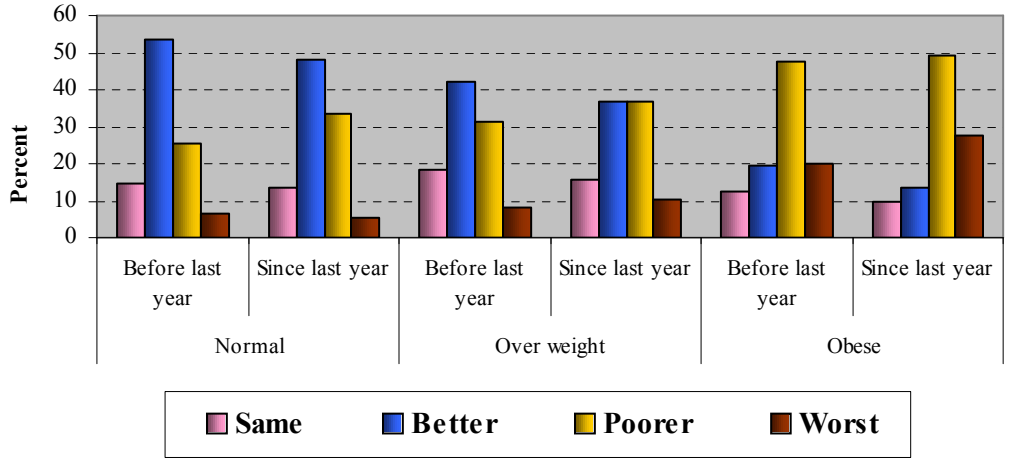
**Table 6: Health status among ever-married women age 20-53 years according to the specified level of body mass index (BMI), Delhi, 2003**

| Health status | Normal | | Overweight | | Obese | |
|---|---|---|---|---|---|---|
| | Before last year | Since last year | Before last year | Since last year | Before last year | Since last year |
| **Health status[1], ***** | | | | | | |
| Same | 14.7 | 13.3 | 18.4 | 15.8 | 12.7 | 9.7 |
| Better | 53.3 | 48.0 | 42.1 | 36.8 | 19.4 | 13.4 |
| Poorer | 25.3 | 33.3 | 31.6 | 36.8 | 47.8 | 49.3 |
| Worst | 6.7 | 5.3 | 7.9 | 10.5 | 20.1 | 27.6 |
| **Number of women** | **75** | | **114** | | **133** | |

[1] Indicates perceived health status of women in comparison to other women of her age.
Note: Chi-square level of significant has been shown only for since last year
Significance level: ***1% level

Similarly, worst health status was significantly higher among obese and overweight women than women with normal BMI. Also, worst health status among obese and overweight women has significantly deteriorated before the last year to since last year. Worse health status has increased from 20 percent to 28 percent among obese women and from eight percent to 11 percent among overweight women. However, there was not much change in the health status over the years among women with normal BMI. This clearly indicates that over the years, health status was deteriorating more among obese and overweight women (Fig 1).

**Fig. 1: Perceived health status before and since last one year according to BMI status of women**



### 6.2.2 Specific morbidity conditions

Table 7 shows the proportion of normal, overweight and obese women by some specific morbidity conditions such as diabetes, hypertension, low blood pressure, thyroid, heart problem, cancer, gallbladder disease, back pain, arthritis, breathlessness while walking, asthma, tuberculosis, swelling of hands and legs, and cholesterol since last one year and before. Among the specific morbidities, arthritis was found to be predominant among obese women (46 percent) and overweight women (39 percent) followed by breathlessness while walking (37 percent among obese women and 27 percent among overweight women) (Fig.6.2). After these two most common morbidities, hypertension (35 percent among obese), back pain (23 percent among obese), and swelling of hands and legs (22 percent among obese) was found significantly higher among obese and overweight women than among women with normal BMI.

**Table 7: Specific morbidity condition among ever-married women age 20-53 years according to the specified level of body mass index (BMI), Delhi, 2003**

| Specific morbidities | Normal | | Overweight | | Obese | |
|---|---|---|---|---|---|---|
| | Before last year | Since last year | Before last year | Since last year | Before last year | Since last year |
| Diabetes*** | 1.3 | 1.3 | 5.3 | 6.1 | 9.0 | 10.4 |
| Hypertension*** | 6.8 | 10.7 | 9.6 | 16.7 | 26.1 | 35.1 |
| Low blood pressure | 13.3 | 17.3 | 8.8 | 14.0 | 8.2 | 9.0 |
| Thyroid** | 1.3 | 1.3 | 2.6 | 3.5 | 9.7 | 10.4 |
| Any heart problem | 0.0 | 1.3 | 1.8 | 5.3 | 3.0 | 3.7 |
| Any type of cancer | 1.3 | 1.3 | 0.0 | 0.0 | 0.7 | 0.7 |
| Liver diseases | 0.0 | 2.7 | 0.0 | 0.9 | 1.5 | 0.7 |
| Gallbladder diseases | 2.7 | 4.0 | 1.8 | 1.8 | 3.0 | 4.5 |
| Back pain | 9.3 | 13.3 | 21.1 | 25.4 | 16.5 | 23.1 |
| Arthritis*** | 16.0 | 24.0 | 29.8 | 38.6 | 29.9 | 45.5 |
| Breathlessness while walking*** | 10.7 | 14.7 | 21.1 | 27.2 | 25.4 | 37.3 |
| Asthma | 4.0 | 4.0 | 3.5 | 4.4 | 7.5 | 9.0 |
| Tuberculosis | 0.0 | 0.0 | 0.0 | 0.0 | 1.5 | 0.7 |
| Swelling of hands and legs*** | 2.7 | 5.3 | 10.5 | 14.9 | 20.3 | 21.6 |
| Cholesterol** | 1.4 | 1.3 | 3.5 | 3.5 | 7.5 | 9.0 |
| **Number of women** | **75** | | **114** | | **133** | |

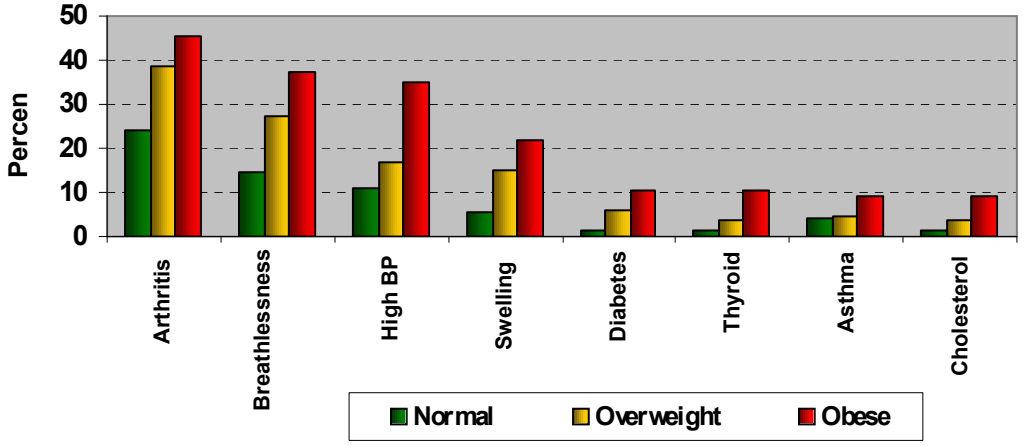
Note: Chi-square level of significant has been shown only for since last year.

Significance level: ***1% level; **5% level

Other morbidities like asthma, cholesterol, diabetes and thyroid were reported by about 10 percent of obese women, almost four to five percent of overweight women whereas only about one percent of women with a normal BMI except for asthma which was about four percent. Moreover, most of the morbidities, which were higher among overweight and obese women, have also increased significantly during the last one year. This shows that obese women are facing a lot of health problems compared to overweight and normal

women and their health status has deteriorated during the one year prior to the survey compared to earlier period.

**Fig. 2: General morbidity conditions among women according to BMI status since last one year**




### 6.2.3 Effect of BMI and WHR on perceived health status

To examine the effect of BMI and WHR on perceived health status of women after controlling for the other background factors, logistic regression models have been applied separately for since last year and before last year taking BMI and WHR in different models. Table 8 presents logistic regression results showing adjusted effects (odds ratio) of BMI, WHR and other background factors on poorer or worst condition of perceived health of ever-married women age 20-53 years in Delhi.

Looking into the perceived health status of women before last year in Model-I, only BMI of women has come out as a significant factor for poorer or worst health condition. The likelihood of women to perceive poorer or worst health condition was almost five times more among obese women with reference to women with a normal BMI. However, other background factors had not shown any statistically significant impact on women's perceived health condition. On the other hand, considering the perceived health status of women in Model-II taking WHR instead of BMI as a factor, WHR and working status of women were found to be significant factors. Women with higher WHR (> 0.90) were more likely to perceive poorer or worst health status with reference to lower WHR (< 0.85). On the contrary, working women were less likely to perceive poorer or worst health status than non working women.

Considering perceived health status of women since last one year again in Model-III, BMI and working status of women were found as statistically significant factors. The likelihood of women to perceive poorer or worst health condition was more than five times higher among obese women compared to women with a normal BMI. However, working women were almost half less likely to perceive their health as poorer or worst with reference to non working women. Moreover, working women also replied that they

could work easily so they have good health. The other background factors have not shown statistically significant impact on women's perceived health condition.

**Table 8: Logistic regression results showing the adjusted effects (odds ratio) of BMI, WHR and other background factors on poorer or worst perceived health status of ever-married women age 20-53 years, Delhi, 2003**

| Selected factors | Before last year | | Since last year | |
|---|---|---|---|---|
| | Model-I | Model-II | Model-III | Model-IV |
| | Exp (β) | Exp (β) | Exp (β) | Exp (β) |
| **Body Mass Index (BMI)** | | | | |
| Normal [R] | 1.000 | | 1.000 | |
| Overweight | 1.394 | - | 1.423 | - |
| Obese | 4.868*** | - | 5.162*** | - |
| **Waist Hip Ratio (WHR)** | | | | |
| < 0.85 [R] | | 1.000 | | 1.000 |
| 0.85-0.90 | - | 1.521 | - | 1.348 |
| > 0.90 | - | 1.697* | - | 1.166 |
| **Age** | | | | |
| 20-29 [R] | 1.000 | 1.000 | 1.000 | 1.000 |
| 30-39 | 1.021 | 1.110 | 0.988 | 1.114 |
| 40-53 | 1.117 | 1.468 | 1.556 | 2.089** |
| **Women's education** | | | | |
| Illiterate [R] | 1.000 | 1.000 | 1.000 | 1.000 |
| Literate, <middle school complete | 0.939 | 1.188 | 0.934 | 1.161 |
| Middle school complete | 1.280 | 1.325 | 1.475 | 1.488 |
| High school complete and above | 0.587 | 0.853 | 1.234 | 1.698 |
| **Religion** | | | | |
| Hindu [R] | 1.000 | 1.000 | 1.000 | 1.000 |
| Muslim | 0.574 | 0.636 | 0.946 | 1.040 |
| Others | 0.673 | 0.612 | 1.108 | 0.987 |
| **Ethnicity** | | | | |
| Scheduled caste/ tribes [R] | 1.000 | 1.000 | 1.000 | 1.000 |
| Other backward class | 1.161 | 1.397 | 0.933 | 1.084 |
| Others | 1.296 | 1.443 | 0.950 | 1.080 |
| **Standard of living index** | | | | |
| Low/ Medium [R] | 1.000 | 1.000 | 1.000 | 1.000 |
| High | 1.119 | 1.146 | 0.592 | 0.627 |
| **Working status** | | | | |
| Not working [R] | | | | |
| Working | 0.562 | 0.455** | 0.484** | 0.383*** |
| **Constant** | **0.491** | **0.356** | **0.816** | **0.689** |
| **-2 Log likelihood** | **394.4** | **413.7** | **394.0** | **415.5** |
| **Nagelkerke $R^2$** | **0.142** | **0.059** | **0.159** | **0.069** |
| **Number of women** | **315** | **315** | **315** | **315** |

- Not included in the models
[R] Reference category;
Significance level: ** p < 0.05; *** p < 0 .01

In Model-IV, WHR was not found to be a significant factor. Only age and working status of women were found to be significant factors for poorer or worst health condition of women. Women of higher age were more likely to perceive for poorer or worst health condition compared to younger women whereas working women were significantly less likely to perceive their health as poorer or worst.

Thus, the result of logistic regression in all the models indicates that higher BMI (obesity) of women has a significantly positive impact on poorer or worst health status of women rather than any other socio-economic and demographic characteristics. However, age and working status of women were also found significant in determining health status of women. Here, it has been also noticed that the value of R square in the WHR models (Model II and IV) were found to be quite lower than the value of R square in the BMI models (Model I and III) taking other factors similar in all the models. This indicates that BMI explains more variability in perceived health status than WHR.

### 6.2.4 Effect of BMI and WHR on different morbidity conditions

Different health problems as discussed above are associated with the obesity and overweight condition of women. However, it has not been clear that these health problems are mostly a result of obesity or overweight condition of women or other background characteristics. In order to examine the effect of BMI and WHR on different morbidity conditions of women, logistic regression model has been carried out separately for BMI and WHR, after controlling for the other socio-economic and demographic characteristics. Table 9 presents logistic regression results showing adjusted effects (odds ratio) of BMI and WHR and other background factors among ever-married women aged 20-53 on selected morbidity conditions like arthritis, hypertension and breathlessness while walking in different models.

Considering arthritis in Model-I, BMI, age, and standard of living of women were found to be statistically significant factors. The likelihood of arthritis increases with an increase in BMI, age and standard of living of women. The likelihood of arthritis was found to be more than two times higher among obese women than women with normal BMI. Further, the likelihood of arthritis increases to more than five times among women aged 40-53 years with reference to women aged 20-29 years. Also, among women belonging to a higher standard of living, the odds ratio was found to be almost double with reference to women belonging to low or medium standard of living. On the other hand, in Model-II, taking WHR instead of BMI as a factor for arthritis, a similar pattern like Model-I was found. Moreover, the likelihood of arthritis was found to be more than three times higher among women with WHR > 0.90 with reference to women with WHR < 0.85.

Considering hypertension in Model-III, a significant impact of factors like BMI, age and working status of women was found. The likelihood of hypertension was significantly higher among women with higher BMI, elderly women and among not working women with reference to working women. The odds ratio was found to be 3.4 times higher among obese women with reference to women with normal BMI. Also the likelihood of hypertension was found five times higher among older women (40-53 years) with

reference to women aged 20-29 years. Working women were found to be almost two and a half times more likely to have hypertension with reference to not working women. In case of Model-IV, a similar pattern was found. However, the likelihood of hypertension among women with high WHR was little lesser in comparison to obese women.

**Table 9: Logistic regression results showing adjusted effects (odds ratio) of BMI, WHR and other background factors on selected morbidity condition from last one year of ever-married women age 20-53 years, Delhi, 2003**

| Selected factors | Arthritis | | Hypertension | | Breathlessness while walking | |
|---|---|---|---|---|---|---|
| | Model-I | Model-II | Model-III | Model-IV | Model-V | Model-VI |
| | Exp (β) | Exp (β) | Exp (β) | Exp (β) | Exp (β) | Exp (β) |
| **Body mass Index (BMI)** | | | | | | |
| Normal[R] | 1.000 | | 1.000 | | 1.000 | |
| Overweight | 1.380 | - | 1.319 | - | 1.283 | - |
| Obese | 2.259** | - | 3.858*** | - | 2.656** | - |
| **Waist Hip Ratio (WHR)** | | | | | | |
| < 0.85[R] | | 1.000 | | 1.000 | | 1.000 |
| 0.85 - 0.90 | - | 1.797 | - | 0.820 | - | 1.436 |
| > 0.90 | - | 3.377*** | - | 2.472** | - | 1.598 |
| **Age** | | | | | | |
| 20-29[R] | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 30-39 | 1.382 | 1.391 | 1.982 | 2.049 | 2.899 | 2.984* |
| 40-53 | 5.272*** | 5.822*** | 4.977** | 5.641** | 4.374** | 5.114*** |
| **Women's education** | | | | | | |
| Illiterate[R] | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| Literate, <middle school complete | 0.751 | 0.835 | 1.087 | 1.430 | 1.029 | 1.251 |
| Middle school complete | 0.618 | 0.533 | 0.671 | 0.539 | 1.614 | 1.833 |
| High school complete and above | 0.631 | 0.701 | 0.648 | 0.888 | 1.326 | 1.619 |
| **Religion** | | | | | | |
| Hindu[R] | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| Muslim | 0.798 | 0.762 | 0.926 | 1.154 | 0.736 | 0.762 |
| Others | 0.464 | 0.418* | 1.481 | 1.503 | 1.077 | 1.005 |
| **Ethnicity** | | | | | | |
| Scheduled caste/ tribes[R] | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| Other backward class | 0.787 | 0.982 | 1.522 | 1.474 | 1.329 | 1.408 |
| Others | 0.825 | 0.864 | 1.143 | 1.145 | 1.477 | 1.650 |
| **Standard of living index** | | | | | | |
| Low/ Medium[R] | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| High | 1.959* | 2.295** | 1.243 | 1.330 | 1.021 | 1.026 |
| **Working status** | | | | | | |
| Not working [R] | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| Working | 0.679 | 0.649 | 2.421** | 2.384** | 1.125 | 0.950 |
| **Constant** | **0.139** | **0.073** | **0.029** | **0.022** | **0.040** | **0.031** |
| **-2 Log likelihood** | **347.6** | **336.8** | **250.7** | **244.4** | **321.7** | **325.0** |
| **Nagelkerke $R^2$** | **0.203** | **0.232** | **0.173** | **0.165** | **0.122** | **0.098** |
| **Number of women** | **315** | **315** | **315** | **315** | **315** | **315** |

- Not included in the models

[R] Reference category;

Significance level: * p < 0.1; ** p < 0.05; *** p <0 .01

Considering morbidity condition of breathlessness while walking in Model-V, a significant impact of the factors like BMI and age was found. The likelihood of breathlessness while walking was two and a half times more among obese women with reference to women with a normal BMI. Similarly, the likelihood of breathlessness while walking was more than four times among women aged 40-53 years with reference to women aged 20-29 years. Other factors were not found to be significant for breathlessness while walking. On the other hand, in Model-VI only age was found to be the significant factor for breathlessness while walking. In the same model, even WHR was not found to be a significant factor.

Thus, from the results of logistic regression for the above three morbidity conditions, BMI and WHR were found to be significant factors whereas other background characteristics except age of women have not come out consistently as significant factors for different morbidities. So it can be concluded that along with age, obesity and higher WHR are important factors in determining the morbidity condition of women.

## 6.3 Reproductive health status

In several studies, mostly conducted in developed countries, a number of reproductive health problems were found to be associated with obesity and overweight condition of women (Lake *et. al.,* 1997; Pettigrew and Hamilton-Fairley, 1997; Rich-Edwards *et. al.,* 1994; Kiddy *et. al.,* 1992; Seidell *et. al.,* 1990; Hartz, *et. al.,* 1984; Yen, 1980) But there is dearth of studies correlating reproductive health problems and obesity in case of Indian women. Therefore, an attempt has been made to look into the reproductive health status of obese and overweight women in Delhi.

### 6.3.1 Reproductive health status and problems

Table 10 presents the reproductive health status of women according to different levels of BMI. Reproductive health problems of women have been studied by collecting information about a number of problems like vaginal discharge accompanied by itching or irritation, abdominal pain and fever, symptoms of urinary tract infection like pain or burning while urinating, and difficult or frequent urination. Also, information has been collected on pain during intercourse, blood visible after sex and about menstrual length, its regularity and problems.

Problems like itching or irritation, and pain or burning while urinating were found significantly higher among obese and overweight women than among women with normal BMI. Itching or irritation was reported by 12 percent of obese women followed by seven percent of overweight women compared to only four percent of normal women. Pain or burning while urinating was reported by six percent of obese women and four percent of overweight women compared to less than three percent of normal women. Pain during intercourse was also reported by a relatively higher percentage of obese women (6 percent) compared to less than three percent among overweight and normal women (Fig. 3). Looking at menstrual length, it was found significantly higher among obese and overweight women than among normal women. A menstrual length of more than four days was found among 25 percent of obese women followed by 19 percent of overweight

women, whereas it was 16 percent among normal women. Regarding menstrual irregularity, both types of menstrual abnormalities i.e. less than 25 days and more than 35 days were significantly higher among obese women and overweight women than normal women. Ten percent of obese women had experienced menstrual abnormality of more than 35 days compared to six percent of overweight women and three percent of normal women. Similarly, menstrual abnormality of less than 25 days was experienced by seven percent of obese women compared to four percent of overweight women and less than two percent of normal women. It is therefore clear from the discussion that most of the reproductive health problems, specifically menstruation related problems were found to be significantly higher among obese and overweight women than women with a normal BMI.

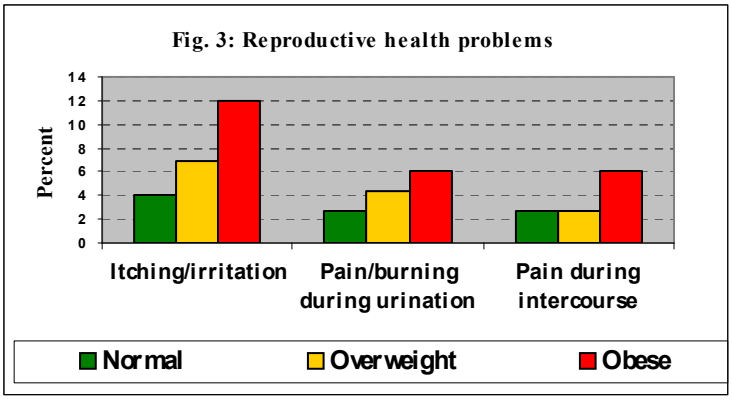



**Table 10: Reproductive health status since last one year among ever-married women 20-53 years according to the specified level of body mass index (BMI), Delhi, 2003**

| Reproductive health status | Normal | Overweight | Obese |
|---|---|---|---|
| Itching or Irritation | 4.0 | 7.0 | 11.9 |
| Abdominal pain | 10.7 | 4.4 | 8.2 |
| Fever | 4.0 | 0.9 | 2.2 |
| Pain or burning during urination | 2.7 | 4.4 | 6.0 |
| Difficult or frequent urination | 9.3 | 14.0 | 9.0 |
| Pain during intercourse | 2.7 | 2.7 | 6.0 |
| Blood visible after sex | 0.0 | 0.9 | 0.0 |
| **Menstrual length[1]** | | | |
| Up to 4 days | 84.1 | 80.9 | 75.0 |
| More than 4 days | 15.9 | 19.1 | 25.0 |
| **Menstrual regularity[2], **** | | | |
| Normal (25-35 days) | 95.0 | 91.0 | 82.7 |
| Abnormal (< 25 days) or (>35 days) | 5.0 | 9.0 | 17.3 |
| **Menstrual problems** | | | |
| Prolonged or heavy period | 0.0 | 2.6 | 3.7 |
| Severe menstrual pain | 5.3 | 4.4 | 6.7 |
| Mid-cycle spotting | 1.3 | 0.0 | 3.7 |
| Premenstrual spotting | 1.3 | 1.8 | 1.8 |
| **Number of women** | **75** | **114** | **133** |

[1] Includes only those women who are currently menstruating

[2] Includes only those women who are currently menstruating and were menstruating before last year

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

### 6.3.2 Effect of BMI and WHR on selected reproductive morbidity conditions

In the above discussion itching or irritation and abnormal menstruation was found to be significantly higher among obese women. Further, to see the adjusted effect of BMI and WHR on selected reproductive morbidity, logistic regression model have been applied separately for BMI and WHR, after controlling for the other socio-economic and demographic characteristics.

**Table 11: Logistic regression results showing adjusted effects (odds ratio) of BMI, WHR and background factors on selected reproductive morbidities since last one year among ever-married women age 20-53 years, Delhi, 2003**

| Selected factors | Itching or Irritation | | Abnormal menstruation | |
|---|---|---|---|---|
| | Model-I | Model-II | Model-III | Model-IV |
| | Exp (β) | Exp (β) | Exp (β) | Exp (β) |
| **Body mass index (BMI)** | | | | |
| Normal[R] | 1.000 | | 1.000 | |
| Overweight | 3.038* | - | 2.090 | - |
| Obese | 3.754** | - | 3.966** | - |
| **Waist Hip Ratio (WHR)** | | | | |
| < 0.85[R] | | 1.000 | | 1.000 |
| 0.85-0.90 | - | 2.305 | - | 1.562 |
| > 0.90 | - | 2.074 | - | 3.047* |
| **Age** | | | | |
| 20-29[R] | 1.000 | 1.000 | 1.000 | 1.000 |
| 30-39 | 1.104 | 1.247 | 0.428 | 0.459 |
| 40-53 | 1.208 | 1.126 | 0.461 | 0.631 |
| **Women's education** | | | | |
| Illiterate[R] | 1.000 | 1.000 | 1.000 | 1.000 |
| Literate, <middle school complete | 0.884 | 3.048 | 0.414 | 0.424 |
| Middle school complete | 1.744 | 4.918* | 0.282 | 0.323 |
| High school complete and above | 0.927 | 1.285 | 0.555 | 0.738 |
| **Religion** | | | | |
| Hindu[R] | 1.000 | 1.000 | 1.000 | 1.000 |
| Muslim | 0.884 | 0.715 | 0.519 | 0.438 |
| Others | 2.014 | 2.518 | 1.832 | 1.959 |
| **Ethnicity** | | | | |
| Scheduled caste/ tribes[R] | 1.000 | 1.000 | 1.000 | 1.000 |
| Other backward class | 0.230 | 1.340 | 0.170 | 0.217 |
| Others | 0.546 | 0.775 | 1.171 | 1.422 |
| **Standard of living index** | | | | |
| Low/ Medium[R] | 1.000 | 1.000 | 1.000 | 1.000 |
| High | 0.628 | 1.121 | 1.526 | 1.971 |
| **Working status** | | | | |
| Not working [R] | 1.000 | 1.000 | 1.000 | 1.000 |
| Working | 0.762 | 0.356 | 1.193 | 1.023 |
| **Constant** | **0.082** | **0.018** | **0.125** | **0.067** |
| **-2 Log likelihood** | **174.1** | **143.8** | **147.8** | **147.9** |
| **Nagelkerke $R^2$** | **0.079** | **0.112** | **0.114** | **0.112** |
| **Number of women** | **315** | **314** | **241** | **241** |

- Not included in the models
[R] Reference category;
Significance levels: * p < 0.1, ** p < 0.05

Table 11 presents the logistic regression results of the adjusted effects (odds ratio) of BMI and WHR and background factors on selected reproductive morbidity conditions such as itching or irritation and abnormal menstruation of ever-married women aged 20-53 years since last one year in different models.

In case of itching or irritation in Model-I, none of the factors had a statistically significant impact except BMI level of women. The likelihood of experiencing itching or irritation was found to be 3.8 times higher among obese women than women with normal BMI. On the other hand in Model-II, except women's education none of the factors were found to be statistically significant. Women who had completed middle school education were found to be almost five times more likely to experience itching or irritation with reference to illiterate women. This may be due to the fact that educated women may be more aware about itching or irritation, which resulted in better reporting.

Considering abnormal menstruation in Model-III, again none of the factors were found statistically significant except BMI level. The likelihood of experiencing abnormal menstruation was found almost four times more among obese women with reference to women with normal BMI. Similarly in Model-IV, except WHR, none of the factors were found to be statistically significant. The likelihood of experiencing abnormal menstruation was found almost three times more among women of WHR > 0.90 with reference to women of WHR <0.85. Thus, the above discussion confirms that obesity is an important factor in determining the reproductive health of women.

## 7. Summary and conclusions

Overall, a significantly higher proportion of women (33 percent) had experienced an increase in their BMI status compared to less than four percent who had experienced a decrease in their BMI status. However, 62 percent of total women had not experienced any change in their BMI status. Also, the change in the BMI status during the last four years shows a significant positive increase in all the three categories (normal, overweight and obese). Almost 40 percent of the normal women followed by 29 percent of overweight women and 20 percent of obese women had experienced a positive change in their BMI level. In contrast, only one percent of normal women, nine percent of overweight women and eight percent of obese women experienced a negative change in their BMI status. Thus, positive weight gain is becoming a serious problem at all the BMI levels of women in general, and among normal and overweight categories in particular. So, this problem needs to be considered very seriously as prevention is better than cure.

According to background characteristics, a significant increase in the BMI status of women was found among women belonging to households with a higher standard of living. Women who have a maid in their house have experienced significantly higher increase in their BMI status compared to women who do not have a maid in their house. Further, a significant differential was found according to type of working of maid (full time or part time). About 77 percent women experienced increase in their BMI status where maid worked full time compared to 47 percent where a maid worked part time. Also, women who are less involved in labour intensive household chores had experienced

a significant increase in their BMI status indicating that a more sedentary lifestyle and less physical activity leads to an increase in the BMI status over a period of time.

Watching television also came out as an important factor. Women who were watching television for more than one hour had experienced 36 percent increase in their BMI compared to 30 percent increase among women watching television up to one hour only. It is very much common that while watching TV, women may eat some food items (mostly fast food and snacks).

Frequency of specific food items also matters. Daily consumption of fried foods shows higher increase in the BMI level of women compared to a relatively less increase among women who eat fried foods less frequently. Consumption of sweets also has a significant association with overweight and obesity. Forty-eight percent women who consume sweets daily experienced an increase in the BMI level compared to about 33 percent women who consume sweets either once a month, occasionally or never. Further, a positive association has been found between the amount of consumption of the specific fatty items and an increase in the level of BMI. A significant relationship has also been found between sugar consumption and an increase in the BMI level of women.

Finally in logistic regression analyses has been carried out to examine the effects of physical activity, diet and other background factors on positive change in BMI status of women in five different models after controlling for each other. Only physical activity and milk consumption were found as statistically significant factors. The logistic regression result confirms that physical activity and dietary habit rather than background characteristics of women are the most significant factors in positive change in the BMI status of women.

General health status has been seen in terms of perceived health status and specific morbidity conditions among women according to different levels of BMI. It is found that significantly higher proportion of obese and overweight women reported poorer and worst condition of their health than women with normal BMI. A significant increase has also been found in the proportion of women reporting poorer health status since last year than before last year. Similarly, worse health status was significantly higher among obese and overweight women than women with normal BMI. All the specific morbidities were found to be more among obese women than overweight women and women with normal BMI. Moreover, most of the morbidities, which were higher among obese and overweight women, have also increased significantly during the last one year. This indicates that obese women are facing a lot of health problems compared to overweight and normal women and their health status has also been deteriorated significantly during the past one year from survey date than earlier period. Logistic regression analysis for selected morbidity conditions like arthritis, hypertension and breathlessness while walking in the different models also confirmed that BMI and WHR are significant factor in determining the morbidity conditions whereas other background characteristics except age of women has not emerged consistently as significant factors.

Reproductive health problems like itching or irritation, and pain or burning while urinating were found significantly higher among obese and overweight women than

among women with normal BMI. Menstrual irregularities of women were also found significantly higher among obese and overweight women than normal women. Logistic regression results also substantiate that none of the factors had a statistically significant impact except BMI level of women in case of itching or irritation. The likelihood of experiencing itching or irritation was found 3.7 times more among obese women with reference to women with normal BMI. Considering abnormal menstruation also, except BMI, none of the factors was found statistically significant. The likelihood of experiencing abnormal menstruation was found almost four times more among obese women than among women with normal BMI. In other model, WHR was also found as statistically significant factor for reproductive morbidities. Thus logistic regression result confirms that obesity and overweight condition of women are important factors in determining the reproductive health of women.

Thus it emerges from the study that we should not put the issue of obesity on the back burner. It was found that there is a significant increase in overweight and obesity among women in Delhi during last four years. So attention should be paid on overweight and obesity coexisting with under nutrition at the national level. Several general and reproductive health problems were found significantly higher among overweight and obese women compared to normal women, therefore obese women should be given special attention by health providers and policy makers. There is an urgent need to recognize the gravity of the problem of obesity and therefore incorporate it in the general health system. A healthy lifestyle should be promoted to tackle this emerging health threat.

**Acknowledgements**

Author is greatly thankful to Prof. Kamla Gupta, IIPS and Dr. Vinod Mishra, ORC Macro for their invaluable comments and suggestions on the different aspects of this study consistently. Prof. M. Guruswamy, IIPS is also acknowledged for his editorial work for the paper.

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