Chapter V

Discussion
DISCUSSION

The results of the present study have been documented in an earlier chapter. In the current chapter findings have been broadly discussed in view of various situations and simultaneously compared with other studies conducted in the country and abroad, if otherwise available. In addition, findings were supported with suitable statistical tools. The flow of the discussion is in accordance to the sequence of the findings shown in tables.

General characteristics of the surveyed females

In view of selecting 300 overweight and obese females, aged 30 to 50 years, 709 females of this specific age group were contacted. Accordingly there was presence of 409 normal females in addition to 300 overweight (07) and obese (293) females. Consequently these numbers provide base for the computation of the figures related to general characteristics (Table 1.1 through Table 1.9) and prevalence of overweight and obesity (Table 2.1 through Table 2.11). Thereafter details of 300 overweight obese subjects are given as per requirement of the questionnaire.

Table 1.1 reflects the age structure of the surveyed females according to overweight and obesity. It was observed that more than two-fifth normal females belonged to age group 45 to 50 years; followed by
35 to 40 years (27.14%) and 30 to 35 years (17.11%). Further nearly half of the obese females belonged to age group 45 to 50 years; followed by 35 to 40 years (24.92%) and 40 to 45 years (16.38%), on the other hand more than two-fifth overweight females (42.86%) are of 45 to 50 years’ age group; followed by 40 to 45 years’ age group (28.57%). Accordingly, mean and standard deviation (SD) age regarding of the surveyed females was computed 41.47 ± 5.76 years of normal; 42.5 ± 5.77 years for overweight and 42.5 ± 5.43 years for obese females. The statistical analysis suggested that the mean ages of the normal and obese females differed significantly (t = 2.416; df = 700, p < 0.02**), whereas mean ages of the other groups were found statistically similar (p > 0.05 NS).

Educational status of the surveyed females has been displayed according to overweight and obesity in Table 1.2. It is evident from the table that nearly one-third of the normal females (33.01%) possessed University education; followed by Secondary (30.56%) and Primary (19.56%) education. In case of obese females, more than one-third females (37.54%) were Secondary educated; followed by University (31.74%) and Primary (19.45%) education. The role of University educated females was 57.14% in the sample; followed by Secondary (28.57%) and Primary (14.29%) education. The statistical analysis conveyed insignificant association ($\chi^2 = 8.854$, df = 8, p > 0.05 NS) between educational status and category of the females.

Table 1.3 illustrates occupational status of the surveyed females according to overweight and obesity. In the present study three occupation categories of the females e.g. exclusive house wife; service and business have been presented. The females engaged in indoor domestic chores have been designated as exclusively house wife; while
the females employed in outdoor activities in government or semi-government or private institutions have been considered in service category. Other females employed in selling and purchasing activities with transaction of money and commodities were included in business category.

In the present study majority of the normal females (90.71%) were house wives; followed by service (8.31%) and business (0.98%) class. Similarly majority of the obese females (88.74%) were house wife; followed by service (10.24%) and business (1.02%) class. On the other hand more than half of the overweight females (57.14%) were related to business category; followed by house wife (28.57%) and service (14.29%) class. The statistical analysis witnessed significant association between type of education and category of the females ($\chi^2 = 142.846$, $df = 4$, $p > 0.001^{***}$). The significant behaviour of the date has no valid scientific reason behind it as most probably it happened due to small sample of overweight females.

Main occupation of the family has been displayed in Table 1.4. Business and service categories have been used in the similar sense as mentioned in Table 1.3, while 'others' category included various occupations like; electricians, T.V. and electronic mechanics, tailors, automobile workers, rikshaw and auto drivers, rajmistri including carpenter and blacksmith or welders and labour engaged in various activities, the persons included in this category were performing hard physical activities.

It is evident from the table 1.4 that more than half of the normal females (52.32%) belonged to business class; followed by service
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(38.63%) and ‘others’ category (9.05%). Similarly more than three-fifth obese females (61.09%); followed by 36.52% and 2.39% were related with business; service and other occupations categories, respectively.

The statistical analysis evidenced significant association between main occupation of the family and category of the females under study ($\chi^2 = 16.479, df = 4, p > 0.01^{**}$). This finding explicitly explores differences in main occupations of the family in view of the category of the surveyed females.

Religion status of the surveyed females has been displayed in Table 1.5. This table shows that majority of the females in all the categories, such as normal (99.27%), obese (99.32%) and overweight (100.00%) belonged to Hindu religion, while the contribution of Muslim females is very small. The Muslims contribute 0.73% in normal and 0.68% in obese category. The statistical analysis emphasized insignificant association between religion and category of the females ($\chi^2 = 0.011, df = 1, p > 0.05$ NS).

Further, socio-economic status of the surveyed females has been illustrated in Table 1.6. Three categories of socio-economic status (low, middle and high) have been considered in view of the present day price index, detailed description of the socio-economic status has already been documented.

It was observed that more than half of the normal females (51.83%) were related with low socio-economic status; followed by middle (28.55%) and high status (19.32%). Likewise more than two-fifth females (42.86%) belonged to low category, while remaining females equally contributed (28.57%) from middle and high categories. So far as obese
females were concerned 33.45% each were from middle and high categories while 33.10% females belonged to low category. There was found significant association ($\chi^2 = 32.444$, df = 4, $p > 0.001^{***}$) between socio-economic status and category of the females.

Table 1.7 reflects information on family structure of the surveyed females according to their category. It is observed that majority of the females in normal (78.73%); obese (76.45%) and overweight (71.43%) categories were related to nuclear families, whereas, contribution of joint families was found 28.57%, 23.55% and 21.27% in overweight; obese and normal categories, respectively. The statistical analysis conveyed non-significant association ($\chi^2 = 0.673$, df = 2, $p > 0.05$ NS) between type of family and category of the females.

Further marital status of the surveyed females according to their categories has been portrayed in Table 1.8. It is observed that all the overweight females (100.00%) were married. In addition, majority of the obese females (92.83%) were also married; followed by widow (6.83%) and unmarried (0.34%). Similarly, majority of the normal females (90.95%) were married; followed by widow (8.56%) and unmarried (0.49%). The statistical analysis witnessed insignificant association between marital status and category of the surveyed females ($\chi^2 = 0.965$, df = 1, $p > 0.05$ NS). This finding suggested similar distribution of various marital status in all the categories of surveyed females.

Family size is a prime factor in consumption of food items and dietary requirements in order to maintain proper health and standard of living. As such family size has direct impact on food consumption and thereby on health and standard of living.
In the present study all the overweight females (100.00%) were related to 4 to 6 family size. Further more than three-quarter normal females (76.04%) were also from the 4 to 6 family size; followed by 1 to 3 (12.71%) and 7 to 9 (9.54%) family size. Similarly nearly three-quarter obese females (72.70%); followed by 12.29% of them were related to family size 4 to 6; 7 to 9 or 1 to 3 size, respectively. The mean ± SD family sizes were enumerated 5.16 ± 1.78 for obese; 5.01 ± 1.62 for normal and 5.00 ± 0 for overweight females respectively. It was further evidenced that the mean sizes of the family members were found statistically similar in all the categories of the females (p > 0.05 NS).

Prevalence of overweight and obesity in the surveyed areas

In the present study four area (a) Mursan Gate (b) Awas Vikas colony (c) Vidyapati Nagar and (d) Delhi wala chowk were purposely selected from four quarters of Hathras City. As per our protocol of selecting 75 overweight and obese females aged 30 to 50 years from each quarter of the city, 161; 173; 205 and 170 females of the specific age group were interviewed from the selected areas e.g. (a) Mursan Gate (b) Awas Vikas colony (c) Vidyapati Nagar and (d) Delhi wala chowk respectively (Table 2.1).

It is evident from the table that the prevalence of overweight was to the tune of 1.18% in over D; followed by over B (1.16%); C (0.98%) and A (0.62%). The statistical analysis conveyed insignificant association between area and prevalence of overweight ($\chi^2 = 0.333, \text{df} = 3, p > 0.05 \text{ NS}$).

So far as prevalence of obesity is concerned, it was evaluated 45.96% for Mursan Gate; 42.94% for Delhi wala chowk; 42.20% for
Awas Vikas colony and 35.61% for Vidyapati Nagar, respectively. The overall prevalences of overweight and obesity for Hathras city were assessed 0.99% and 41.33%, respectively. Further statistical analysis witnessed similar rate of obesity prevalence in four quarters of the city ($\chi^2 = 4.427, \text{df} = 3, p > 0.05 \text{ NS}$). The figures of the present study are in lines with the rates quoted by Sidhu and Tatla (2002). These authors quoted rates in Delhi urban females as 33.4%; in Hyderabad urban females as 36.3% and in Delhi urban females as 48.6%.

When the same data is presented according to present age of the surveyed females (Table 2.2), it was observed that the prevalence of obesity and overweight respectively were evaluated 31.73% and 0.96% for 30 to 35 years; 39.46% and 0.54% for 35 to 40 years; 43.24% and 1.80% for 40 to 45 years and 44.98% and 0.97% for 45 to 50 years age group. Though there is an increasing trend of obesity prevalence with respect to present age of the surveyed females, but it could not be statistically established and the variations in obesity prevalence were found due to chance factor ($\chi^2 = 6.088, \text{df} = 3, p > 0.05 \text{ NS}$). Similarly there was no significant association between present age of the females and prevalence of overweight ($\chi^2 = 1.130, \text{df} = 3, p > 0.05 \text{ NS}$). Hence our hypothesis ‘Prevalence of overweight and obesity increases with the advancement of age of the subjects’ is accepted, but it is statistically not significant.

Further prevalence of overweight and obesity were considered according to educational status of the surveyed females (Table 2.3). It is evident from the data that the prevalences of overweight were 0.72% for Primary, 0.84% for Secondary and 1.72% for University educated females. Though prevalence of overweight seems increasing with
advancement of educational status, but it was statistically insignificant ($\chi^2 = 1.701$, df = 2, $p > 0.05$ NS). The differences observed are due to chance factor.

It is further evident from the table that prevalence of overweight and obesity combined were assessed 31.91% for illiterate; 42.02% for Primary and 47.25% for Secondary educated females. This rate in Secondary educated females was maximum and there after deterioration in prevalence was observed and it comes to 41.81% level in University educated females and 37.50% in professional females. The statistical analysis witnessed non-significant association between prevalence of overweight and obesity combined and educational status of the females ($\chi^2 = 6.642$, df = 4, $p > 0.05$ NS). In other studies, Mohammad Ali and Lindstrom (2005) and Vahratian (2009) have also reported increase in obesity up to 12 standard of education. The reason of this variation is unexplainable. That is why statistical analysis suggested the role of chance factor.

Again further, the same data has been illustrated according to occupation of the surveyed females (Table 2.4). It was observed that the prevalence of overweight and obesity combined was minimum (41.39%) in housewives and maximum (63.64%) in business category females, while 47.69% females in service category were found overweight and obese. Though a wide variation in prevalence of overweight and obesity was seen in various occupation categories but the association was found statistically insignificant ($\chi^2 = 3.040$, df = 2, $p > 0.05$ NS). In a study held in Australia, Ball, Mishra and Crawford (2002) documented lowest obesity in the professionals working for the longer duration. In an Indian study NFI (1999): Scientific Report 15 desk worker females were more
involved in obesity in comparison to their counterparts in non-desk working females and the difference was formed statistically significant ($p > 0.04$).

A sedentary life style plays a significant role in obesity. Heavy activities are liable to burn extra calorie consumption but in case of sedentary life style extra calorie is not burnt and the carbohydrate/glucose are deposited in the body causing obesity. In the present study the type of work performed by the females is considered (Table 2.4.1). It was observed that the prevalence of obesity and overweight in the females involved in heavy activities was only 12.50%, while it was 47.79% in the moderate working females and highest (59.62%) in sedentary working females. These was significant association between type of work and prevalence of overweight and obesity ($\chi^2 = 51.635$, df = 2, $p > 0.001^{***}$). Hence, the hypothesis “Working mode or physical activity has significant impact on overweight and obesity” is accepted.

The works conducted in various parts of the world WHO, 2009; and Ness-Abramof and Apovian, (2006) have mentioned increasing use of mechanized transportation and a greater presence of labour saving devices in home are responsible for sedentary working of the house wives and ultimate increase in obesity tremendously.

It has been generally observed that the food consumption practices in different religious are different due change in climatic conditions and availability of food-products to the consumers. Religions bindings are also responsible for their food habits. In this perspective, the prevalence of overweight and obesity was considered (Table 2.5). In the present study, the prevalence of overweight and obesity were observed 42.33%
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and 40.00% respectively in Hindu and Muslim females. The statistical analysis evidenced non-significant association between religion and prevalence of overweight and obesity ($\chi^2 = 0.004$, df = 1, $p > 0.05$ NS). The number of Muslim females is very small as such the inference drawn by this data is not rational. In a study held in Varanasi, Asthana nee Sahay (1993) has also reported similar prevalence of overweight and obesity in Hindu and Muslim females.

Wang (2001) has quoted that Sobal and Stunkard, after examining over 140 published studies, they concluded inverse relationship between SES and obesity among women in developed societies. In contrast, in developing countries a strong relationship exists between SES and obesity among men, women and children. In the present study, prevalence of overweight and obesity is presented in Table 2.6. It is evident that combined prevalence of overweight and obesity is 32.05% in low and 45.87% in middle and 55.87% in high socio-economic groups. The statistical analysis emphasized significant association between income/socio-economic group and prevalence of overweight and obesity ($\chi^2 = 28.061$, df = 2, $p < 0.001^{**}$). Hence, the hypothesis "income or socio-economic status has no significant effect on the prevalence of overweight and obesity" is out rightly rejected. It is further observed that obesity alone is also associated with the socio-economic status ($\chi^2 = 27.965$, df = 2, $p < 0.001^{**}$) of the females, but it is disheartening that overweight alone was not associated with the socio-economic status ($p > 0.05$ NS). Most probably it is due to small sample of overweight females as 7 only.

In a study held in Varanasi Asthana nee Sahay (1993) has reported insignificant association between income and obesity in an affluent
society. The study was conducted in the same group with respect to variation in income. The study subjects were living similar life style and consumption pattern of food items was also similar. In the studies held in abroad Wang (2001) has also reported high prevalence of obesity in high income groups of China. Further Penny Gordon-Larsen et al. (2003) mentioned that overweight prevalence decreased with increasing SES among white females and remained elevated and even increased among higher SES African-American females. African-American/white disparity in overweight prevalence increased at the highest SES. Conversely disparity was lessened at the highest for white, Hispanic and Asian females.

Family structure is also an important facet in occurrence of overweight and obesity. It is considered that the persons living in different family structure spent different types of life style. A change in life style causes difference in the prevalence of overweight and obesity. If the life style is same in both types of families, it is expected similar rates of prevalence of overweight and obesity.

In the present study prevalence of overweight and obesity has been displayed in Table 2.7. It is observed that the combined prevalences of overweight and obesity were assessed 41.56% and 44.94% respectively in nuclear and joint families. The statistical analysis witnessed insignificant association between type of family and prevalence of overweight and obesity ($\chi^2 = 0.573$, df = 1, $p < 0.05$). This result shows similar rate of prevalence in nuclear and joint families. Further the result concludes that the females living in nuclear and joint families are spending similar life style and their food consumption pattern is most probably similar. In a study held in Varanasi Asthana nee Sahay (1993) has also reported slight
higher prevalence (30.83%) in joint families in comparison to nuclear families (28.7%), but the difference was found statistically insignificant.

Increasing number of members in the family reduces percapita income and simultaneous reduction in percapita income is responsible for low consumption of nutrients and availability of other necessities. In the present study it is observed that the lowest prevalence (40.91%) of overweight and obesity existed in 1 to 3 family members category (Table 2.8), while the females related with crowded members’ family had highest prevalence (53.33%). The females related with families having 4 to 6 and 7 to 9 family members respectively encountered with 41.43% and 48.00% prevalence of overweight and obesity. Though the prevalence is found increasing with the increase of members in the family, but it was found statistically insignificant for obesity ($\chi^2 = 2.598$, df = 3, $p < 0.05$ NS) and for overweight and obesity combined ($\chi^2 = 1.980$, df = 3, $p < 0.05$ NS). The result showed that the variation in prevalence was due to chance factor.

There are several events in the life of a woman, which may be associated with weight gain. These include marriage (the initiation of treatment with oral contraceptives), pregnancy and menopause. Lowe and Gibson (1955) observed that at the same ages married woman without children are heavier that single women (unmarried). Pregnancy increases the weight gain of many women who experienced large weight gains during pregnancy. In this work he described weight gain varying from 28 pounds (12.7 kg) to 110 (50 kg). Mekeown and Record (1957a, b, c) re-examined the change in body weight of women who delivered babies between April 1949 and March, 1950. Maternal weights were obtained early in pregnancy and corrected to the 124th day of gestation.
apparent that substantial weight gain (over 50 pounds) in pregnancy occurred was less than 1 per cent of the sample.

In the present study, the prevalence of overweight and obesity (Table 2.9) was observed 33.33%; while it was 36.36% in widow and 42.86% in married females. Though a wide variation in prevalence of overweight and obesity was present, but the association of prevalence with marital status was found statistically insignificant ($\chi^2 = 0.976$, df = 2, $p < 0.05$ NS). High prevalence of obesity in married women is fully in accordance with the statements quoted by Lowe and Gibson (1955); In a study held in Varanasi Asthana nee Sahay (1993) noticed significantly higher prevalence in obesity in married women (36.60%) in comparison to unmarried girls (9.68%). In this respect the hypothesis ‘The marital status has no positive role to effect overweight and obesity’ is rejected.

Obesity is mainly dominant due to viscous circle of physical activity and extra consumption of energy causing deposition of unwanted fat in the body. Any activity related to these factors directly or indirectly affects overweight and obesity. Likewise the number of children a person has is related to their risk of obesity. A woman’s risk increases by 7% per child, while a man’s risk increases by 4% per child Weng et al., (2004). This could be partly explained by the fact that having dependent children decreases physical activity in western parents Bellows-Riecken & Rodes, (2008).

In the present study (Table 2.10), the prevalence of obesity was observed 30.00% in nil parity, 39.74% in 1 to 3 parity and 47.71% in more than four parity. Similarly, combined prevalence of overweight and obesity was accounted 40.00% in nil parity; 40.29% in 1 to 3 parity and
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49.67% in more than four parity. Though increasing trend in prevalence is observed with the advancement of parity, but the association between prevalence of overweight and obesity and number of parity was found statistically insignificant (\( \chi^2 = 4.330, \text{df} = 2, p < 0.05 \text{ NS} \)) and the variation observed was due to chance factor. As such the hypothesis 'Number of parity in the females is responsible to enhance the prevalence of overweight and obesity' is accepted, but it is not statistically significant suggesting that the study be carried out taking a large sample size.

Prevalence of overweight and obesity was worked out according to food habit of the females in term of vegetarian and non-vegetarian. In the present study (Table 2.11) the prevalence of obesity was accounted 40.94% for vegetarians and 52.00% for non-vegetarians. Further, the combined prevalence of obesity and overweight was assessed 41.81% in vegetarian females and 56.00% in non-vegetarians. The statistical analysis conveyed non-significant association between food habit and prevalence of obesity (\( \chi^2 = 1.218, \text{df} = 1, p < 0.05 \text{ NS} \)) and overweight combined (\( \chi^2 = 1.989, \text{df} = 1, p < 0.05 \text{ NS} \)). This result is indication of similarity in vegetarian and non-vegetarian diet. Actually, in practical sense, vegetarians and non-vegetarians used to consume similar diets. Non-vegetarian diets are usually expansive and they are very rarely used by the consumers; normally used once or twice in a month. In view of strict definition, these non-vegetarians are practically vegetarian. In her study Asthana nee Sahay (1993) has also mentioned similarity in the diets of vegetarians and non-vegetarians because for all practical purposes, the non-vegetarians were vegetarian food consumers. As due to rising cost of non-vegetarian food items, small quantity of these items is purchased for
the family leaving very little for an individual and too little for females, who eats in the last, according to our social milieu.

Specific information regarding overweight and obesity before providing nutrition education

Knowledge status of the overweight and obese females regarding this disease has been shown in Table 3.1 overall more than three quarters of the subjects (77.67%) had knowledge of this disease. According to income, it was found 66% in low, 83% in middle and 84% in high income groups. There was an increasing trend in knowledge status with the advancement of income ($\chi^2 = 11.801$, df = 2, $p < 0.01^{**}$).

So far as consequences of this disease are concerned, 15.33% females reiterated as they seem aged and they have acquired more weight with respect to their height. Further 18.33% females understood that their weight was 10 to 20% more than the normal weight, while more than one-quarter females (28.67%) had knowledge of all the above consequences.

Various problems occurred in the subjects due to presence of this disease. Nearly two-fifth females (37.0%) said that they felt problem in working and walking, while 28.67%, 16.33% and 10.67% females encountered with pain in joints; high breathing and other, respectively.

Bloom and Eidex (1967) found that obese subjects spent more time in activities that required little energy than did lean subjects. The obese tended to spend more time in bed, and when out of bed, to spend more time sitting than did lean people. Further Durnin et al. (1957) found that the obese women spent 5% less time in moderate activities and 5% were time sitting than the lean women. Mayers et al. (1956) reported that body
weight was significantly related with activity choice, with obese subject choosing escalator over stairs more frequently than overweight and normal weight subjects.

**Positive family history**

In human beings possible role of genetics was first brought into light by the studies of Von Verachuer (1927), who in a study of twins found body weight to be contrast from twin to twin. In a series of 250 obese patients studied by Rony in Chicago (1940) 69 per cent had one or both parents obese. In a recent study Farooqui (2005) reported resemblance of BMI in 50 to 90 % of the offsprings or borns of latter generations.

It is well known fact that hormones play an important role in the deposition of fat. These are several endocrine abnormalities which can cause mild or moderate degree of obesity Bray (1974c). The obese state in addition to including certain metabolic abnormalities, also results in a number of physiological alterations. Obesity is identified as a risk factor for diseases like hypertension, diabetes, coronary heart disease, gall stones and contributed to reduced life expectancy.

In view of the above mentioned consequences, the females were interrogated regarding family history of these diseases from the maternal and paternal sides (Table 3.2). It is observed that the obesity; diabetes; hypertension; coronary heart disease and others in maternal sides were present in 30.33%; 13.00%; 26.00%; 1.33% and 4.00% subjects respectively. On the other hand, towards paternal side these diseases were present in 26.33%; 11.67%; 23.00%; 1.33% and 2.67% families, respectively. The figures showed that obesity and hypertension had
leading role in positive family history either in maternal or paternal side. Further coronary heart disease has been found least occurred as positive family history.

**Exercise practiced**

Activity is very important facet for any therapeutic programme to the obese patients. Studies have shown that obese persons are less active than their lean counterparts Braunstein, (1975) and that this inactivity does play a significant role in their positive calorie or energy balance. A significant loss of energy can be induced by encouraging increased physical activity in obese patients. This increase in activity can be in the form of brisk walking or engaging in sports such as swimming, golf, and tennis. But, it should be emphasized that any programme of activity should began with a small increase over the usual activity pattern and a gradual activity pattern and a gradual progressive increase to the desired amount Braunstein, (1975).

In the present study, nearly three-fifth females (59.00%) (Table 3.3) did not practice any kind of physical activities. Among the physical activity practitioners, nearly one quarter females (24.00% were engaged in yoga practices; followed by walking (23.00%). In addition, 1.67%; 1.00% and 0.33% females participated in sports and playing; cycling or gym exercises and dancing respectively.

So far as frequency of these activities is concerned, nearly one-third females (31.00%) participated in these activities daily; followed by twice a week (9.33%) and 5 days in a week (0.67%). The income has no significant bearing on the physical activities performed by the females.
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In a study held in USA, Simoes et al. (2006) have quantified physical activities and described associations of physical activity and BMI. These authors mentioned that significantly more of those respondents who were classified as obese reported functional limitation (43.3%) than did those classified as overweight or underweight/normal. Obese individuals had a higher percentage of dependency as measured by ADL (activity of daily living), and IADL (instrumental activities of daily living) (21.5%) than did those underweight or normal or overweight. Compared to those who were physically active, the physically inactive had a higher percentage of dependency in ADL (10.0%), or IADL (28.8%) and functional limitation (44.5%). Leisure time physical activity (LPA) was initially assessed by past month participation in any physical activities or exercise such as running, golf, gardening or walking for exercise. Activities of daily living (ADLs) are basic activities that include bathing, dressing, toileting, transfer and feeding. Persons are limited in an ADL, if they are unable to perform the activity, use active help, use equipment, or require standby help.

Habit of TV viewing by the females has been presented in Table 3.4. It is observed that more than three-fifth overall females (65.33%) viewed TV for less than one to four hours; followed by four hours (20.00%). Mean ± SD period of TV viewing was estimated 2.65 ± 1.21 hours. According to income group minimum mean ± SD (2.49 ± 1.46 hours) period was accounted for low income and highest (2.88 ± 0.89 hours) for high income. There was significant difference in mean periods between high and low income (t = 2.281; df = 198, p < 0.05\*) categories, but there was no significant difference in mean TV viewing periods of
two consecutive groups, i.e. between middle and low; and between high and middle income groups ($p < 0.05$ NS).

Jacoby et al. (2003) have also reported that obese women and those in the high income group tended to watch more TV; while men in the high income group were those who spent less time in front of TV sets. The finding also showed a significant positive correlation between hours reported sitting and watching television and physical activity in both men and women ($p < 0.01^{***}$). Among men and women who reported sitting and watching more than 4 hours of television per day, more than half of men and women were categorized into lower levels of physical activity. Speakman (2004) mentioned high rate of obesity in persons watching TV for more than four hours in a day. The author remarked that television viewing is negatively associated with engagement in physical activity. Tucker and Bagwell (1991); Gortmaker et al. (1996); Vioque et al. (2000) and Ezekiel (2008) have also mentioned an association between the number of hours of television watched and the prevalence of obesity.

Obesity can occur only as a result of energy intake in excess of energy expenditure. If an individual ingests and stores 100 kcal more than is required/day, then 36500 excess kcal will accumulate during the course of one year and this will result in a weight gain of 46 kg in one year. There are many factors which influence food intake and energy output.

Food habit and consumption practices of food items have been shown in Table 3.5 and Table 3.5.1. It was observed that overwhelming majority of the females (95.33%) were vegetarian, while only 4.67% females were regular non-vegetarian. According to income category, there was no significant association between vegetarian/non-vegetarian
food habits and income of the females ($\chi^2 = 1.048$, df = 2, $p < 0.05$ NS). Further 92.00% overall females reiterated meal requirement after feeling hungry. Though meal requirement after feeling hungry was found deteriorated with the advancement of income, but its association with income was found statistically insignificant ($\chi^2 = 5.706$, df = 2, $p < 0.05$ NS).

It is satisfactory that two-thirds overall females did not feel hungry during tension, but 22.00% and 11.33% females felt more and less hunger respectively. The association was found statistically significant ($\chi^2 = 20.973$, df = 4, $p < 0.001^{***}$). Further nearly three-fifths overall females used to drink tea or coffee twice daily; followed by more than two times (21.67%) and once daily (18.67%). The drinking habit of tea or coffee was found significantly increasing with increase of income ($\chi^2 = 17.502$, df = 4, $p < 0.01^{***}$). Due to economic constraints the low income persons avoid more drinking of tea or coffee. On the other hand, more frequency of drinking tea or coffee in high income families is status symbol. In addition 20.33% and 12.00% overall females liked soft drinks and mattha or lemon water respectively. More then one-fifth (24.00%) over all females used to drink cold drinks once a day; followed by twice a day (8.33%). The frequency of drinking cold drink was found insignificantly associated with income category ($\chi^2 = 4.954$, df = 4, $p < 0.05$ NS) i.e. use of cold drink was found similar in all the income categories.

It is a known fact that consumption of sweets is responsible for accumulation of extra energy in the body. In the present study (Table 3.5.1) more than three-fifth overall females used to consume sweets. Of these more than one-third of them (34.67%) consumed sweets irregularly; while 19.33% and 8.67% females utilized sweets once or twice in a week.
The figures showed that there was significant association between liking of sweets and income of the subjects ($\chi^2 = 39.279$, df = 6, $p < 0.001$***). The use of sweets was found increasing with the increase in income. The use of sweets has also become a status symbol, and thereby the persons in high income category have much liking for sweet dishes. Sweet dishes along with presence of sugar are also rich in dried fruits having excess nutrients causing obesity and other related diseases to the consumers.

Some persons are habitual to take snacks, biscuits and petty food in terms in between two meals. This habit of nibbling between meals, though in small quantity, is also responsible for consumption of extra energy and thereby accumulation of fat in the body. In the present study 5%; 31% and 62% females respectively from low; middle and high income groups were habitual for nibbling habit was found significantly increasing with increase in income ($\chi^2 = 74.041$, df = 2, $p < 0.001$***).

Present day taking meal out of the home has become a fashion and status symbol of affluent society. In the present study too (Table 3.5.1), 65% females in high income group along with 23% females in middle income category against none in the low income category used to take out side of the house. This habit has positive association with income category ($\chi^2 = 104.82$, df = 2, $p < 0.001$***). Further speed of taking meal is also responsible for ingestion and proper digestion of meal. The food items taken fastly are generally undigested while slow habit of taking meal helps in proper digestion. It is satisfactory that more than half of the overall females (56.67%) consumed meal slowly and there was also significant association between speed of taking meal and income of the subjects ($\chi^2 = 63.558$, df = 2, $p < 0.001$***).
Other habits such as comparison during taking meal; participation in lunch party outside of the house and use of left out foods have also positive bearing on consumption of extra energy and thereby accumulation of extra fat in the body. Habit of taking meal during watching TV is responsible to consume more food than required. In the present study this has been found significantly associated ($\chi^2 = 70.675$, df = 4, $p < 0.001^{***}$) with income. Further there were only 14.33% subjects who either were participating in professional lunch party or as a member of kitty party. In the modern culture, participation in lunch party is also increasing day by day in view of gratifying status symbol. Our hypothesis that ‘eating habit significantly influences the prevalence of overweight and obesity’ is absolutely accepted in view of the aforesaid statements regarding various characteristics of eating habits of the females in the study.

The knowledge of the nutrients (Table 3.6) was only known to 30.67% overall females still a significant increasing trend in knowledge ($\chi^2 = 29.189$, df = 2, $p < 0.001^{***}$) status was obtained. In the present study 11% low; 36% middle and 45% high income category females had proper knowledge of the nutrients. Consequently, in 27.67%; 27.00%; 22.00%; 18.00% and 11.00% females respectively had correct knowledge of protein; fat, vitamins; carbohydrate and minerals and the knowledge of these nutrients were significantly associated with the income category ($p < 0.001^{***}$). There was increasing trend in knowledge status with the advancement of income.

The knowledge of nutrients was found responsible to increase use of salad (68.00%); liking and consumption/intake of fruits (78%) and taking breakfast (69.33%). These habits are good and fulfil RDA
requirement of the subjects. But due to economic constraints these habits of using salad ($\chi^2 = 17.371$, df = 2, $p < 0.001^{***}$); liking and taking of fruit ($\chi^2 = 173.474$, df = 8, $p < 0.001^{***}$) and habit of taking break fast ($\chi^2 = 265.889$, df = 4, $p < 0.001^{***}$) were not similarly followed by the females in all income categories. In a recent study Duvigneaud et al. (2007) mentioned that in women, the intake of carbohydrates; starch, sugars and fibres were found to be positively related with overweight and obesity.

Though three-fifth overall females (60.00%) did not adhere restriction, still 31.33%; 3.67%; 2.67% and 2.33% overall females were habituated to restrict fatty diets; sweets; rice and cold items and fried food items respectively. The significant restriction by the subjects in high income category is applaudable as they consume extra nutrients for the sake of high standard of living and maintaining status quo. There were very few subjects (5.67%) (Table 3.7) taking some kinds of medical treatment for the elimination and prevention from overweight and obesity.

No other endocrine gland has been so implicated in obesity as the thyroid. Obesity can result from hypothyroidism because of decreased calorie need. Thyroid function studies in obese have shown variable results. Thyroid functions are depressed in obese subjects as reported by Koltz (1970), where as study done by Glennon and Herch (1965) reports contrary to this, i.e. the level of circulating hormone and radio active iodine uptake was more or less normal. Bray et al. (1973) suggested that administration of thyroid hormone to obese patients may result in a loss of lean body mass exceeding loss of fat, and an increased appetite. In the present study (Table 3.8), overall 13.67% subjects faced problem of
thyroid and this problem was found statistically similar ($\chi^2 = 4.124$, df = 2, $p > 0.005$ NS) in all the income categories.

Addiction habit is injurious and detrimental to the health as it affects directly or indirectly to the appetite and consumption of varied quantity of the nutrients. In the present study, (Table 3.9) only 13.00% subjects were habituated with some sorts of addiction of these 7.67%; 4.00% and 1.33% subjects were tobacco; rajanigandha or betel leaf users. On the other hand more than two-fifths of family members were also involved in taking some sorts of addiction. The addiction habits either for the subjects or for family members were found statistically similar ($p > 0.05$ NS) in all the income categories. Large scale American and European studies have found that mortality risk varies with BMI; the lowest risk is found at a BMI of 22.5 to 25 kg/m$^2$ in non-smokers (Whitlock, 2009) and at a BMI of 24 to 27 kg/m$^2$ in current smokers mortality increases with changes in either direction Calle, (1999); Pischon et al., (2008).

**Assessment of obesity**

For routine use, anthropometric measurements are the most practical tools for diagnosis obesity. Broadly, anthropometry aims at measurement of weight and measurement of subcutaneous fat. Some commonly quoted anthropometric indices are weight and height relationship; weight as percent of reference weight; weight-height indices; skin fold thickness as a measure of body fat and per cent body fat. In the present study, BMI and SFT (skin fold thickness) have been considered for measuring subcutaneous fat.
Table 4.1 presents distribution of the subjects according to BMI and income group before implementation of nutrition education. It was observed that nearly half of the overall subjects (47.67%) were obese grade II (35.0-39.9); followed by obese grade-I (30.0 to 34.9) (43.67%). In addition, 6.33% and 2.33% overall females were obese grade-III and overweight, respectively. The mean ± SD BMI was enumerated 35.35 ± 3.23. According to income of the subjects, the mean ± SD values of BMI were assessed 35.20 ± 3.13 for low; 35.55 ± 3.08 for middle and 35.30 ± 3.50 for high income groups. The statistical analysis witnessed that the mean values of BMI were similar in all the income groups and the differences between two mean values were due to chance factor (p > 0.05 NS).

Further biceps measurement of these females has been shown in Table 4.2. It was observed that the biceps measurement two-fifth subjects was 10 to 15 mm; followed by 15 to 20 mm (22.33%) and 5 to 10 mm (17.33%). In addition, biceps measurement of 10.67%; 6.33%; 3.00% and 0.33% subjects were recorded 20 to 25 mm; 25 to 30 mm and 30 to 35 mm, respectively. The mean ± SD biceps measurement was assessed 13.70 ± 5.80 mm. According to income group of the subjects, the mean ± SD values of biceps measurement were ascertained 13.65 ± 5.72 mm; 13.65 ± 5.68 mm and 13.80 ± 6.06 mm for low; middle and high income groups. Further there were no significant differences between means (p > 0.05 NS) and further the mean difference between two groups was due to chance factor.

So far as triceps measurement of the subjects was concerned, mean ± SD value was obtained 18.80 ± 6.80 mm for overall females, while the values for low; middle and high income groups were 18.40 ± 7.60 mm;
18.55 ± 6.66 and 19.15 ± 6.12 mm, respectively (Table 4.3). The mean values of triceps measurements were found statistically similar for three income groups (p > 0.05 NS). Slusser et al. (2004) mentioned ≥ 95th percentile TSF value as a criterion for obesity. Study done by Khalid et al. (2005) on the prevalence of obesity in urban population based on triceps skin-fold thickness in relation to body weight showed prevalence of obesity in males and females (based on triceps skin fold thickness using Seitzer and Mayer criterion) as 2.2% and 10.4%, respectively.

Again further mean ± SD value of suprailliac measurement of the subjects was accounted 22.88 ± 6.03 mm. According to income group the measurements were 21.85 ± 5.21 mm for low, 23.50 ± 6.70 mm for middle and 23.30 ± 6.02 mm for high income group females. These mean values of suprailliac measurements were found statistically similar for all income groups (p > 0.05 NS) and the differences observed between two means were due to chance factor (Table 4.4).

Distribution of subcapular measurement is shown in Table 4.5. It was observed that the subcapular measurement in more than one-third overall females was 25 to 30 mm; followed by 30 to 35 mm (24.33%) and 20 to 25 mm (20.67%). The mean ± SD value of subcapular measurement was computed 27.58 ± 5.99 mm for overall subjects, while these values for low; middle and high income groups were 26.90 ± 5.96 mm; 28.35 ± 5.99 mm and 27.45 ± 5.99 mm, respectively. The mean values were found statistically similar for all income groups (p > 0.05 NS).

BMI is not an exact measure of body fat. BMI for age based standards such as that of Must et al. (1991) or Cole et al. (2000) appear to be more preferable to use than the WHO criteria (which are based on both
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BMI and skin fold). Skin fold thickness measurements are subject to considerable inter and intra user error, whereas measures based on height and weight are simple to obtain in wide variety of settings and reliable Himes, (1989). This is particularly relevant to developing countries, where people lightly skilled in skin fold measurement are scarce. The high subcutaneous fat in adolescents suggested by the high percentage of obese boys and girls identified using the composite BMI and skin fold criteria (i.e. WHO recommended criteria) is a cause of concern since it is known that the reliability of skin fold measurement decreases as body fat increases. Furthermore, the use of a BMI reference such as that of Must et al. (1991) or Cole et al. (2000) would allow ease of comparison with corresponding studies from other countries in the world.

Sum of SFT at four sites included the biceps, triceps, sub scapular and supra iliac. This criteria of classification has been used by Durnin and Womersley (1974). According SFT based on four sites was considered normal from 40 to 59.9 mm; overweight from 60 to 79.9 mm and ≥ 80.0 mm as obese, respectively.

In the present study (Table 4.6), according to SFT criteria 66.00% females were detected obese; whereas 25.00% and 9.00% females were overweight and above normal, respectively. On the basis of BMI criteria 2.33% females were overweight and remaining 97.67% females were obese grades I, II and III (Table 4.1). It is evident that 9.00% females which were detected above normal by SFT criteria and further by using BMI criteria they had been recognized falsely as obese Must et al. (1991) and Cole et al. (2000) have rightly mentioned that BMI is not an exact measure of obesity and consequently they recommended to use WHO criteria, which are based on both BMI and skin fold.
Table 4.6 further showed that mean ± SD of SFT measurement of overall females was accounted 81.35 ± 13.06 mm. According to income group, the mean ± SD values of SFT measurement were worked out 81.55 ± 13.98 mm for low; 79.55 ± 13.17 mm for medium and 82.95 ± 11.85 mm for high income group. The statistical analysis emphasized insignificant difference in mean values of different income groups, i.e. the mean SFT values in all the income groups were statistically similar (p > 0.05 NS).

Consumption of nutrient by the overweight and obese females before implementation of nutrition education

The higher intake of energy by the overweight and obese subjects could be one of the factors contributing to their energy intake. In a study Shah and Robert (1991) examined the studies that investigated food intake, physical activity, basal metabolic rate and thermogenesis etiology. Energy intake appears to be only weakly related to obesity, but diet contribution, especially dietary fat may make significant contribution to body weight. Welle et al. (1992) reported that overweight women tended to expend more energy in terms basal metabolic rate.

For maintaining good health and physical efficiency the nutrients should be taken in correct proportion and in adequate amounts. The excess of proximate principles leads to over nutrition. However, their requirements vary according to nature of work and energy output of an individual. Thus it is the balance between energy intake and energy output which is an important deciding factor. The daily requirements of different nutrients have been recommended by various national and international bodies, like (a) Nutrition Expert Committee ICMR, India
In the present study a dietary survey was conducted to study the food behaviour of the subjects. For this purpose oral questionnaire method for 24 hours' food recall was used. The nutrient intakes worked out were matched against the recommended allowances given by ICMR (2004).

Protein consumption by the females has been illustrated in Table 5.1. It is evident that more than two-fifth over all females (40.67%) consumed 80 to 100 gm protein per day; followed by 60 to 80 gm (33.33%) and 100 to 120 gm (20.33%). In addition 4.00% and 1.67% overall females used to take 40 to 60 gm and 120 to 140 gm protein in a day, respectively. . The mean ± SD amount of protein consumption was assessed 83.67 ± 24.54 gm per day. According to income category the mean ± SD consumptions of protein were obtained 73.00 ± 10.78 gm for low; 86.40 ± 14.87 gm for middle and 98.40 ± 16.13 gm for high income group. The statistical analysis envisaged that the protein consumption was significantly increasing with the increase in income (p < 0.001***).

Indian Council of Medical Research (2004) recommends 50 gm RDA of protein to the females employed in sedentary moderate or heavy activities. In view of this recommendation only 20% overall females were consuming proper quantity of the protein, whereas majority of them (98.00%) were taking protein more than their requirements. According to income category, 96.0% low; 98.5% middle and 99.5% high income females consumed more than the recommended amount of protein. This
high consumption of protein is one of the vital cause of overweight and obesity in them.

In a study held in Varanasi Asthana nee Sahay (1993) have also reported high protein consumption in comparison to RDA by the obese females. Mikkelson et al. (2000) mentioned that high protein diet might increase 24-hours energy expenditure by 2 to 3%, such an effect can not account for more than a small fraction of the observed weight loss, while Porrini et al. (1997) expressed that high protein content induces a stronger satiating effect than fat and carbohydrate.

Further, consumption of fat by the females has been shown in Table 5.2. It is observed that more than one-third overall females (33.67%) consumed 60 to 80 gm fat in a day; followed by 80 to 100 gm (30.67%); 40 to 60 gm (16.67%) and 100 to 120 gm (14.67%). The mean ± SD daily consumption of fat by these females was computed 79.60 ± 21.35 gm. According to income category, the females related to low; middle and high categories consumed fat 60.40 ± 11.88 gm; 80.00 ± 15.70 gm and 98.40 ± 16.13 gm, respectively. The statistical analysis suggested that the mean consumption of fat is significantly increasing with income (b < 0.001*** i.e. the consumption of fat is directly dependent on income status of the subjects.

The RDA of fat consumption has been mentioned 20 gm in a day for the non-pregnant females (ICMR, 2004). In this perspective, the overweight and obese females in every income category consumed more and more than the recommended allowance. The fat consumption in the study subjects are more than three to five times of the RDA (ICMR, 2004).
The findings of the present study has full agreement with the figures of fat consumption reported by Asthana nee Sahay (1993) in a study conducted in Varanasi. In her study, the researcher has mentioned beyond 30 gm of fat consumption by all the obese subjects.

Consumption of carbohydrate has been presented in Table 5.3. It is observed that more than two-fifth overall females consumed 400 to 500 gm of carbohydrate in a day; followed by 300 to 400 gm (29.00%) and 500 to 600 gm (19.67%). The mean ± SD consumption was assessed 441.33 ± 88.79 gm. According to income category, the mean ± SD consumptions were obtained 455.00 ± 90.31 gm for low; 437.00 ± 84.88 gm for middle and 432.00 ± 90.32 gm for high income category. The statistical analysis conveyed that similar mean amount of carbohydrate is consumed by the females in all the three income categories (p > 0.05 NS).

When the calorie equivalence is determined by the mean consumption of carbohydrate it was assessed that 77.45%; 74.38% and 73.53% RDA requirement of the calorie is fulfilled in the females related to income groups low, middle and high respectively. This finding shows that the diet in the present study is mainly based on carbohydrate sources. Duvigneaud et al. (2007) have also reported significantly higher percentages of energy from protein, carbohydrate and fibre, and lower percentage of energy intake from fat. Similar observations were also reported by Flegal et al. (2002) and Wright (2004).

So far as energy consumption is concerned (Table 5.4), it was observed that nearly one-fifth overall females (19.67%) consumed 2500 to 2750 Kcal per day; followed by 2250 to 2500 Kcal (19.00%); 2750 to 3000 Kcal (17.00%) and 3000 to 3250 Kcal (12.33%). The overall mean
± SD amount of calorie consumption was accounted 2761.67 ±492.92 Kcal and this mean amount is equivalent to 124.12% of the RDA. According to income category, the mean ± SD amounts of energy consumption were obtained 2652.50 ± 508.63 Kcal for low; 2787.50 ± 550.52 Kcal for middle and 2845.00 ± 452.66 Kcal for high income category. These mean amounts are equivalent to 119.21%; 125.28% and 127.87% of the RDA in low; middle and high income groups. High energy intake by the obese subjects has also been reported in an earlier study held in Varanasi (Asthana nee Sahay, 1993). These findings confirmed our hypothesis ‘Nutrients are responsible to cause over weight and obesity’. The over weight and obese females in the present study consumed more amounts of protein fat carbohydrate and energy than the RDA.

Excess calcium consumption in obese women has been documented by the earlier workers Duvigneaud et al., (2007). These authors reported that women with abdominal obesity showed a significantly higher calcium intake compared to lean women, but this trend was not significant in men.

In the present study (Table 5.5), more than one-fifth overall females (23.67%) consumed 600 to 800 mg of calcium in a day; followed by 400 to 600 mg (18.33%); 800 to 1000 mg (16.67%) and 1000 to 1200 mg (14.00%). The mean ± SD amount of calcium intake was assessed 913.33 ± 336.15 mg. In view of recommended allowance, the mean consumption of calcium is 228.33% of the RDA. The recommended daily allowance of calcium is 400 mg (ICMR, 2004). According to income category, the mean ± SD amounts of calcium were ascertained 758.0 ± 283.26 mg; 902.00 ± 405.51 mg; and 1080.00 ± 380.85 mg for the
females related to low; middle and high income groups, respectively. It is very interesting that the consumption of calcium is significantly increasing with the advancement of income \((p > 0.05\ NS)\). This finding established that the females in the present study were consuming calcium nearly two times or more than two times of the RDA.

So far as consumption of iron is concerned, the daily recommended allowance is 30 mg in Indian women (ICMR, 2004) involved in sedentary works. In the present study (Table 5.6), nearly one-third overall females \((30.00\%)\) consumed 20 to 30 mg of iron; while 29.67\%; 16.33\% and 17.33\% overall females were consuming 30 to 40 mg; 40 to 50 mg and 50 to 60 mg of iron in a day. The mean ± SD amount iron consumption was computed 37.60 ± 12.43 mg, and this mean amount was 125.33\% of the RDA (ICMR, 2004). According to income category, the mean ± SD amounts of iron consumption were assessed 32.40 ± 10.11 mg; 39.40 ± 12.90 mg and 41.00 ± 12.47 mg, respectively for the females related to low; middle and high income categories. The females in middle \((t = 4.271, df = 198, p < 0.001^{***})\) and high income \((t = 5.606, df = 198, p < 0.001^{***})\) categories consumed quantity of iron more than the amount of iron consumed by the females in low income group. In other studies, more consumption of iron than the RDA was also reported Duvigneaud et al., (2007) in obese women.

**Effect of Nutrition Education Package**

Effect of nutrition education has been evaluated in order to provide feedback to the beneficiaries and in accordance suggestions were given. The information of the post nutrition education period was compared with
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pre-education period and the effect of nutrition education programme was worked out.

Table 6.1 illustrates type and frequency of physical exercise practiced by the overweight and obese females at pre and post experimentation periods. It was observed that initially 59.00% females did not perform any kind of physical exercise, while after nutrition education 14.00% more females were encouraged to perform some sorts of physical exercise. Consequently at post implementation period, walking, yoga and cycling and Gym were performed by 26.67%; 38.67% and 2.67% females in comparison to 23.00%; 24.00% and 1.00% females at pre experimentation period. The statistical analysis evidenced that there was significant increase in physical activities due to implementation of nutrition education programme ($\chi^2 = 7.531, \text{df} = 1, p < 0.01^{**}$).

Even the frequency of physical activities were also found increased ($\chi^2 = 15.101, \text{df} = 3, p < 0.01^{**}$). The frequency of physical activities at post experimentation reached to 38.00% for daily; 5.33% for five days in a week and 11.33% for two days in a week from 31.00%; 0.67% and 9.33%, respectively at pre experimentation period.

At present television viewing has become an essential part of the modern life. It has become a prime source of entertainment, information and education and mostly the people are attached with television programmes. Initially 10.67% females did not view TV and after the education programme there was an increase of 4% in this behaviour. The mean ± SD period of TV viewing was computed 2.65 ± 1.21 hours at pre implementation of the nutrition programme and it reduced to 2.53 ± 1.34 hours at post implementation period. Though there was reduction of 0.12
hours in the period of TV viewing, but the mean difference of TV viewing was found statistically insignificant ($t = 0.924, df = 448, p > 0.05$ NS).

**Change in Food Habit (Table 6.3)**

As majority of the females (95.3%) were vegetarian at the initial phase of the study, but this habit was not changed at the final stage (93.33%). The nutrition education has no impact to change the food habit of the females ($\chi^2 = 0.792, df = 2, p > 0.05$ NS). It was observed that there was change in meal requirement of the females. There were 97.33% females at post experimentation period against 92.00% at pre experimentation phase who required meal after feeling hungry. The change was found statistically significant ($Z = 2.605, p < 0.01^{**}$). In addition feeling hunger during tension was significantly deteriorated ($\chi^2 = 9.968, df = 2, p < 0.01^*$); drinking tea or coffee was reduced ($\chi^2 = 11.056, df = 2, p < 0.01^{**}$); liking for sweets ($\chi^2 = 13.996, df = 3, p < 0.01^{**}$); use of cold drink ($\chi^2 = 9.911, df = 2, p < 0.025^{**}$); nibbling between meals ($\chi^2 = 34.965, df = 1, p < 0.001^{***}$); participation in lunch party out side of the house and taking meal outside of the house ($\chi^2 = 43.731, df = 1, p < 0.001^{***}$) were significantly changed after the nutrition education. Further habit of taking meal slowly ($\chi^2 = 12.811, df = 1, p < 0.001^{***}$); and taking meal with family members ($\chi^2 = 6.499, df = 2, p < 0.05^*$) were significantly enhanced. Instead of throwing left out foods, it was given to needy and hungry poor persons ($\chi^2 = 129.468, df = 2, p < 0.001^{***}$) and it was the best utilization of the left out foods.

Above mentioned good practices regarding food consumption were developed in the subjects due to nutrition education provided to them.
Further use of salad (Table 6.4) increased significantly from 680.00% to 78.67% after the education programme ($\chi^2 = 5.590, df = 1, p < 0.025^{**}$). Even the use of fruits daily (26.00%) or twice a week (68.00%) elevated to this level from 23.33% (daily) and 12.33% (twice a week), respectively. This finding showed significant change in the habit of using fruits ($\chi^2 = 176.428, df = 3, p < 0.001^{**}$). Srivastava and Madhu (2005) suggested low carbohydrate diet in management of obesity by providing adequate quantity of salads and non-starchy vegetables. Duvigneaud et al. (2007) mentioned that energy content of fibre per unit weight food is low. Consequently, inclusion of fibre in a diet reduced energy density. Dietary fibre tends to reduce dietary intake by slowing digestion and absorption of nutrients, and by increasing the production of gut hormones enhancing satiety feeling. Moreover, some types of fibre reduce the overall absorption of fat and protein.

The proper knowledge of the nutrients (Table 6.5) enhances their consumption subject of availability and approachability depending on purchasing power of the beneficiary. The nutrition education programme was found successful to increase significantly the knowledge of the nutrients, like, protein; carbohydrate; fat; vitamins and minerals ($\chi^2 = 4.456, df = 1, p < 0.05$). This finding is fully in accordance with the hypothesis that nutrition education enhances knowledge of the nutrients significantly.

Initially, nearly one-third females (30.67%) were not taking breakfast (Table 6.6), but this habit was reduced to 8.00% at post phase of the nutrition education, more than three-fifth females (62.67%); followed by 29.33% used to take breakfast frequently or daily instead of 41.67% and 27.67%, respectively from the initial phase ($\chi^2 = 31.392, df = 2, p < 0.001^{**}$).
Huenemann et al. (1966) noted a reduction in the number of breakfast eaten by the obese boys and girls.

The frequency of food consumption plays an important role in the genesis of obesity. It is known that taking one meal per day opposed to two or three has metabolic consequences independent of calorie intake. Epidemiological studies have shown a clear negative correlation between number of meals and obesity, therefore the meals, the greater the tendency towards obesity Fabray et al., (1966). The frequency of eating also changes the metabolism of glucose and concentration of cholesterol. Cohn (1964) found that when normal volunteers ate several small meals a day, they had lower concentrations of cholesterol than when the same total intake was eaten in a few large meals. This reduction of cholesterol with frequent ingestion of small meals has been confirmed in other studies Yong et al., (1972). Glucose tolerance curves were also improved when eating three or more meals as compared with one or two large meals. In brief, it can be said that frequency of eating is inversely related with obesity.

In the present study (Table 6.7), it was observed that overwhelming majority of the overweight and obese females (98.33%) consumed meal two times in a day; followed by three-times in a day before implementation of the nutrition education. There after providing nutrition education to these females 14.00% of them used to take meal three-times daily. The figures showed that 12.33% more females adopted three-times meal pattern instead of two-times a day. This quality of meal diversion is found statistically significant ($\chi^2 = 27.941$, df = 1, $p < 0.001^{**}$). This habit will certainly prove a green signal towards improvement of obesity in the females.
It has already been mentioned that overweight and obese women reported a higher consumption of fats and proteins, whereas their energy percentages from carbohydrates and fibres were lower compared to their normal weight counterparts. It is therefore, for the sake of restricting overweight and obesity, more consumptions of protein, fat and sugar be avoided and on the other hand the energy intakes from carbohydrates and fibres should be encouraged. In the present study (Table 6.8), nearly one-third females (31.33%) restricted fatty food items before implementation of education programme. In addition 3.67%, 2.67% and 2.33% females also avoided intakes of sweets; gaseous and cold items, and fried items. After providing nutrition education to the females, 42.67%, 8.67% and 2.67% and again 2.67% of them started restriction of fatty items; sweets, fried items and gaseous and cold items, respectively. The restriction was found significantly associated with the nutrition education ($\chi^2 = 13.494, \text{df} = 4, p < 0.01^{**}$). This finding suggested that there was significant change in habit of following restrictions of food items like, fatty, fried, sweets, gaseous and cold items before and after implementation of nutrition education package.

It has already been mentioned that every type of addiction is injurious and detrimental to health as this habit is directly or indirectly responsible to appetite and consumption of the nutrients. Various workers like, Calle (1999); Pischon et al. (2008) and Whitlock (2009) reported higher mortality in obese persons with smoking habit; while the mortality in non-smoking overweight and obese persons was normal. In the present study, the overweight and obese subjects (Table 6.9) were cautioned with the harmful consequences of the addiction, still only one percent subjects and 0.33% family members of the subjects left addiction habit. These
changes are statistically insignificant ($p < 0.05$ NS). This result showed that the nutrition education programme was unable to change the addiction habit of either of the subjects or of their family members. It is evident from the table that 13.00% subjects and 45.00% family members of the subjects were habituated with same sorts of addiction in the pre-experimental phase of the nutrition education programme. Further these figures reached to 14.00% (the subjects) and 45.33% (the family members of the subjects) after providing nutrition education to the subjects. Actually the nutrition education was not provided to the family members and they were indirectly educated through the overweight and obese subjects of the family, participating in the nutrition education programme. Change in addiction habit requires strong will power to leave it. Though through media and other communication sources, government and non-government agencies are trying their best to educate the people against addiction habit, still a high positive result is awaited.

A nutrition package for weight loss of the desired subjects was introduced according to calorie reduction schedule. The details are given elsewhere. The BMI of the subjects were worked out at two phases i.e. one before implementation of the nutrition package and second after the programme (Table 6.10). It was observed that initially 47.67% and 43.67% subjects were related to BMI categories 35.0 to 39.9 and 30.0 to 34.9, respectively. In addition 6.33% and 2.33% subjects belonged to BMI categories $> 40.0$ and 25.0 to 29.9, respectively. It is applaudable that there were no subjects belonging to BMI category $> 40$, after the implementation of the nutrition package. Majority of the subjects (80.0%), followed by 38.67% switched back to BMI categories 30.0 to 34.9 and 35.0 to 39.9, respectively. The mean ± SD values of BMI were
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ascertained 35.35 ± 3.23 and 34.52 ± 2.56 at pre and post phases of the programme. A reduction of 1.03 kg/m² has been found statistically significant (t = 3.677, df = 448, p < 0.001***). It is inferred that the nutrition package provided to the subjects was fully successful towards its role.

It has already been mentioned that skin-fold thickness (SFT) technique was also employed as an alternative method of obesity measurement. Accordingly, the SFT measurement of the subjects as per criteria documented by Durmin and Womersley (1974) was followed at beginning and after the implementation of nutrition package (Table 6.11). It was observed that initially 66.00% subjects were obese according to this procedure and remaining 25.00% and 9.00% subjects belonged to overweight (60 to 79.9 mm) and above normal (40 to 59.9 mm) categories. After providing nutritional package to the desired subjects, 49.33% were over-weighted (SFT: 60 to 79.9 mm); while 46.67% and 4.00% females were obese (SFT: ≥ 80 MM) and above normal (SFT: 40 to 59.9 mm), respectively. The mean ± SD values of SFT were assessed 81.35 ± 13.06 mm; and 78.48 ± 11.43 mm, respectively at pre and post phases of the nutrition education. An absolute reduction in SFT amounting 2.87 mm (mean difference of SFT assessed at pre and post phases) was found statistically significant (t =2.392, df = 448, p < 0.02**).

Consumption of nutrients by the overweight and obese females at pre and post implementation periods of nutrition education package (Table 6.12).

Diet therapy is one of the most important strategies for weight loss and weight maintenance. The person should be put in negative energy
balance, ideally 500 to 1000 Kcal less than RDA. An ideal reduction of 500 to 1000 gm per week is approved once the target is fixed, progress should be checked once a month. Reducing excessive food sources of fat and sugars can dramatically reduce calories for many overweight people (Srilakshmi, 2005).

In the present study (Table 6.12), the mean ± SD amounts of nutrients such as protein, fat, carbohydrate and energy were ascertained 83.67 ± 24.54 gm, 79.60 ± 21.25 gm, 441.33 ± 88.79 gm and 2761.67 ± 492.92 Kcal, respectively at pre implementation of the nutrition education. Further, mean ± SD values of these nutrients were reduced to 67.17 ± 13.19 gm, 47.83 ± 13.64 gm, 352.50 ± 73.70 gm and 2007.17 ± 373.96 Kcal at post education phase, respectively. It was further assessed that there was 19.72% reduction in mean amount of protein (t = 9.271, df = 448, \( p < 0.001^{***} \)); 39.91% reduction in mean amount of fat (t = 19.173, df = 448, \( p < 0.001^{***} \)); 20.13% reduction in mean amount of carbohydrate (t = 11.237, df = 448, \( p < 0.001^{***} \)) and 27.32% reduction in mean amount of energy (t = 18.076, df = 448, \( p < 0.001^{***} \)). The reductions in the nutrients due to nutrition education were found statistically significant.

It is reported that in low carbohydrate diet, the weight loss is associated with only the duration of diet and restriction of energy intake, not with carbohydrate restriction itself. Those on the low carbohydrate diet had lost 3 to 9 kg more weight after six months, but at 12 months the difference was no longer significant Stern et al., (2004). Foster et al. (2003) mentioned the Atkins diet or an energy restricted diet with an energy content of 25% fat, 15% proteins, and 60% carbohydrate for reduction in weight. After 6 months the low carbohydrate group did
better, with a weight loss of 7.0% (SD = 6.5) Vs. 3.2% (SD = 5.6, \( p = 0.02 \)), but after 12 months the difference between the groups was again no longer significant (4.4% Vs. 2.5%) (SD = 6.3). Astrup (2008) was also of the view that low carbohydrate diet is not a palatable diet in the long-run. The author described that the combination of reduction of dietary fat and energy, and increased physical activity has been shown to reduce the incidence of diabetes by 58% and reduction in dietary fat and increase in fibre were the strongest predictors of weight loss.

In the nutshell, the role of nutrition education was found significantly effective to enhance physical exercise (regular walking and practicing yoga); practicing good food habits along with adequate use of salad; fruits and green leafy vegetables (subject to availability and approachability); habit of taking breakfast regularly and required quantity of diets in more frequencies; avoiding sweet dishes; fatty-fried items and cold drinks; knowledge of nutrients and reduced period of TV viewing. In view of these findings the nutrition education has significant impact on food habit is accepted.