
# RESULTS AND DISCUSSION

The results of the present study on **Bone Mineral Health of Women and Impact of Intervention Strategies** is presented and discussed under the following headings:

**A. Socio-Economic Profile, Food Consumption Pattern, Life Style and Other Background Details of the Selected Women**

1. Socio-economic profile of the selected women
2. Food consumption pattern, dietary and other details of the selected women
3. Life style pattern of the selected women

**B. Nutritional, Health Status and Bone Health Profile of the Selected Women**

1. Anthropometric measurements of the selected women
2. Bone Mineral Density of the selected women
3. Clinical problems of the selected women
4. Biophysical and Biochemical assessment of the selected women
5. Dietary assessment of the selected women
6. Reproductive history of the selected women

**C. Formulation and Testing of the Supplements**

1. Acceptability scores of the nutri mixes
2. Nutrient content of the nutri mixes
3. Shelf life of the nutri mixes
4. Cost of the nutri mixes

**D. Impact of the Supplementation Study**

1. Anthropometric measurements of the selected women
2. Bone Mineral Density of the selected women
3. Biochemical assessment of the selected women

**E. Impact of Nutrition Education**

Nutrition knowledge score of the selected women

## A. Socio-Economic Profile, Food Consumption Pattern, Life Style and Other Background Details of the Selected Women

### 1. Socio-Economic Profile of the Selected Women

Health and nutritional status of a person are exaggerated by an adverse socio-economic status of the family (Darman and Drewnowski, 2008). As stated by Rahman and Phillips (2008), the demographic factors like age, sex, marital status, educational level, family type, income level and outlay pattern are the aspects that influence the socio-economic status and also play an essential role on the food consumption pattern and the nutrient intake of the individuals.

The socio-economic details of the selected women are discussed under the following headings.

#### a. Age of the Selected Women

The details concerning the age of the selected women are depicted in Table III.

**TABLE - III**

**AGE OF THE SELECTED WOMEN**

| Age (years) | No. | Per cent |
|---|---|---|
| **21 – 30** | 312 | 14 |
| **31 – 40** | 714 | 32 |
| **41 – 50** | 602 | 27 |
| **51 – 60** | 401 | 18 |
| **61 – 70** | 201 | 9 |
| **Total** | **2230** | **100** |

Among the 2230 selected women 32 per cent being the majority belonged to 31 to 40 years of age followed by 27 per cent belonging to 41 – 50 years of age. Only 9 per cent of them were between 61 to 70 years of age. The threat of osteoporosis increases with age, though it can also develop in young people.

**b. Educational Status of the Selected Women**

Table IV presents the details regarding the educational status of the selected women.

**TABLE - IV**

**EDUCATIONAL STATUS OF THE SELECTED WOMEN**

| Educational status | No. | Per cent |
|---|---|---|
| **Primary school** | 422 | 19 |
| **High school** | 320 | 14 |
| **Higher secondary** | 571 | 26 |
| **Under graduate** | 479 | 21 |
| **Post graduate** | 200 | 9 |
| **Uneducated** | 238 | 11 |
| **Total** | **2230** | **100** |

With regard to the educational status of the selected women 26 per cent being the majority had higher secondary education followed by 21 per cent with under graduate education and only 9 per cent had post graduate education. Among the selected women 11 per cent did not have any education which is a discouraging observation. Educational level is a socio economic factor that can influence nutrition knowledge and help people to manage very effectively various health related problems.

According to Maddah *et al.,* (2011), educational level is associated with bone health of selected population of women with high occurrence of osteoporosis among lower social groups. Good educational level and increasing affluence in developing regions lead to better nutrition practice and changeover

towards healthy behaviours associated with better bone mineral density (Suzanne *et al.,* 2005). It has been reported that higher education was independently associated with greater use of bone density test among the elderly white women (Dishi, *et al*., 2012).

**c. Occupational Status of the Selected Women**

The particulars regarding the occupation of the selected women are given in Table V.

**TABLE - V**

**OCCUPATION OF THE SELECTED WOMEN**

| Occupation | No. | Per cent |
|---|---|---|
| **Business** | 380 | 17 |
| **Government** | 223 | 10 |
| **Private** | 468 | 21 |
| **Unskilled work** | 312 | 14 |
| **Unemployed** | 580 | 26 |
| **Retired** | 267 | 12 |
| **Total** | **2230** | **100** |

In the present study among the selected women, 62 per cent being the majority were employed in occupations like business (17%), government sector (10%), private concern (21%) and unskilled work (14%), followed by 26 per cent without any proper jobs. It is also seen that 12 per cent of women have retired from jobs.

Badusha *et al.,* (2015) reported that low bone mineralization is seen among hard working labourers (88%) because of insufficient calcium intake in diet, retired persons (78%) due to decreased physical movements and office going persons (72%) owing to poor exposure to sunlight.

**d. Marital Status and Type of Families of the Selected Women**

Table VI depicts the marital status and type of families of the selected women.

**TABLE - VI**

**MARITAL STATUS AND TYPE OF FAMILIES OF THE SELECTED WOMEN**

| Marital status | No. | Per cent |
|---|---|---|
| **Married** | 1985 | 89 |
| **Unmarried** | 245 | 11 |
| **Total** | **2230** | **100** |
| **Family type** | **No.** | **Per cent** |
| **Nuclear** | **1360** | **61** |
| **Joint** | **870** | **39** |
| **Total** | **2230** | **100** |

Marital status of the selected women revealed that a majority of 89 per cent were married and a minority of 11 per cent remained unmarried. Due to progress in technological development and rapid industrialization the traditional joint families have been relocated to nuclear family systems. It is observed that 61 per cent being the majority of the families were of nuclear type and the remaining 39 per cent followed joint family system. This finding is similar to the study reports of Ashwani (2011), that among the Indian families more than 80 per cent belonged to nuclear family type.

**e. Monthly Income of the Families of the Selected Women**

Family income is an influential determinant of a household's ability to attain food and therefore poverty is a major threat to household food security (Vijayalakshmi, 2002). The details of the monthly income of the families of the selected women are given in Table VII.

**TABLE - VII**

**MONTHLY INCOME OF THE FAMILIES OF THE SELECTED WOMEN**

| Monthly Income (Rs.) * | No. | Per cent |
|---|---|---|
| **Low Income (3301 - 7300)** | 375 | 17 |
| **Middle Income (7301 - 14500)** | 1410 | 63 |
| **High Income (≥ 14501)** | 445 | 20 |
| **Total** | **2230** | **100** |

* - 11th five year plan technical report (2007-2012)

In the present study, among the selected families a maximum of 63 per cent belonged to middle income category with Rs. 7,301 to Rs.14,500 as monthly income followed by high income among 20 per cent and only 17 per cent were found to be in low income category based on the classification of 11th five year plan technical report 2007 - 2012.

In a study among Indian women aged 30-60 years from low income groups, BMD at all the skeletal sites were much lesser than values reported from developed countries, with an elevated incidence of osteopenia (52%) and osteoporosis (29%) might be due to inadequate nutrition (Shatrugna, *et al*., 2005).

**f. Monthly Expenditure Pattern among Families of the Selected Women**

The monthly expenditure details among the families of the selected women are given in Table VIII.

**TABLE - VIII**

**MONTHLY EXPENDITURE PATTERN AMONG FAMILIES OF THE SELECTED WOMEN (N=2230)**

| Particulars | Percentage of Expenditure | | | | | |
|---|---|---|---|---|---|---|
| | 0 – 25% | | 26 – 50% | | 51 – 75% | |
| **Food** | 1985 | 89 | 178 | 8 | 67 | 3 |
| **Clothing** | 1650 | 74 | 491 | 22 | 89 | 4 |
| **House rent** | 1695 | 76 | 379 | 17 | 156 | 7 |
| **Education** | 1405 | 63 | 825 | 37 | - | - |
| **Medicine** | 1494 | 67 | 736 | 33 | - | - |
| **Other services** | 1826 | 82 | 404 | 18 | - | - |
| **Savings** | 1516 | 68 | 714 | 32 | - | - |
| **Recreation** | 1628 | 73 | 602 | 27 | - | - |

It is observed from the table that a majority of 89 per cent of the selected families of women spent 0 - 25 per cent and a minority of 3 per cent spent 51 - 75 per cent of their income towards food. About 74 per cent of them spent 0 - 25 per cent on clothing. With regard to house rent a maximum of 76 per cent of families spent up to 25 per cent. Concerning expenditure on education 63 per cent being the majority of the selected families spent 0 - 25 per cent. Most of them spent 0-25 per cent towards medicine (67%), other services (82%), savings (68%) and recreation (73%).

## 2. FOOD CONSUMPTION PATTERN OF THE SELECTED WOMEN

The food consumption pattern of the selected women is discussed under the following headings.

### a. Diet Pattern

Table IX illustrates the details on diet pattern of the selected women.

**TABLE - IX**

**DIET PATTERN OF THE SELECTED WOMEN (N=2230)**

| Diet Pattern | No. | Per cent |
|---|---|---|
| **Vegetarian** | 608 | 27 |
| **Non vegetarian** | 1291 | 58 |
| **Ova vegetarian** | 331 | 15 |
| **Total** | **2230** | **100** |
| **Consumption of No. of meals per day** | | |
| **<3 Meals** | 334 | 15 |
| **3 Meals** | 1316 | 59 |
| **>3 Meals** | 312 | 14 |
| **Irregular meals** | 268 | 12 |
| **Total** | **2230** | **100** |
| **Skipping meals** | | |
| **Yes** | 803 | 36 |
| **No** | 1427 | 64 |
| **Total** | **2230** | **100** |
| **Reasons for Skipping Meals** | | |
| **Household work** | 257 | 32 |
| **Lack of appetite** | 153 | 19 |
| **Lack of time** | 209 | 26 |
| **Cultural reasons** | 120 | 15 |
| **Weight Reduction** | 64 | 8 |

The findings revealed that a majority of 58 per cent of the selected women were practicing non vegetarian diet pattern, followed by vegetarians 27 per cent and a minority of 15 per cent ova-vegetarians. This illustrates that non vegetarian diet pattern is more common among the selected women population. India is believed to be designated as a vegan country habitually, but the food behaviour and food preferences are steadily changing.

According to Hindu (2006) only 31 per cent of Indians are vegans followed by ova vegetarians 9 per cent and a greater part of 60 per cent remained as non-vegetarians. The results of the present study also showed a high prevalence of non vegetarians among the selected women. Badusha *et al.,* (2015) stated that low bone mineralization is prevalent among vegetarians (77%) compared to non vegetarians (66%). Praminslaw (2002) reported that intake of high protein animal foods may help bone mineralization. According to Suman *et al.,* (2013), those consuming mixed category of diet may have extra BMD compared to vegans.

Many research studies performed on vegetarians, lacto ova-vegetarians and omnivores have ended that there are several factors distressing bone mineral metabolism and therefore it is not likely to declare rigidly the control of some dietary existence above another. The vegetarian food supply better amount of vitamins and minerals and help in enhanced bone metabolism functions. The acid content of non vegetarian foods initiates and speed bone demineralisation as seen by serial bone mineral density studies. Hence the agreement is removed on the advantage of a vegetarian diet over a non-vegetarian diet (www.bhj.org.in).

With regard to the meal pattern of the selected women, majority of them followed three meal pattern (59%), followed by less than three meal pattern (15%), more than three meals (14%) and a minority had irregular meals. It is observed that a majority of 64 per cent of the selected women followed regular food consumption and a minority (36%) were skipping their meals. The reasons for skipping their meals included household work (32%), lack of appetite (19%), morning hour rush (26%), weekly fasting (15%) and health conscious feeling to reduce body weight (8%).

**b. Foods Avoided**

The details of foods avoided by the selected women are given in Table X.

**TABLE - X**

**FOODS AVOIDED BY THE SELECTED WOMEN**

**(N=2230)**

| Foods avoided | No. | Per cent |
|---|---|---|
| **Yes** | 937 | 42 |
| **No** | 1293 | 58 |
| **Total** | **2230** | **100** |
| **Type of Foods Avoided*** | **No.** | **Per cent** |
| **Milk products** | 580 | 26 |
| **Fried items** | 428 | 19 |
| **Preserved products** | 379 | 17 |
| **Nuts and oilseeds** | 513 | 23 |
| **Sweets** | 312 | 14 |
| **Specific fruits / vegetables** | 401 | 18 |

* Multiple response

From the table it is revealed that a majority of 58 per cent of the selected women did not restrict any foods and a minority of 42 per cent of them avoided certain foods in their diet. The specific foods restricted by the selected women included milk products (26%), fried items (19%), preserved products (17%), nuts and oilseeds (23%), sweets (14%) and specific fruits / vegetables (18%).

According to Hong *et al.,* (2013), osteopenia and osteoporosis affected groups had lesser intake of milk, vegetables and fruits than the normal group and there was significant positive relationship between the intake of vegetables and fruits and bone mineral densities.

**c. Consumption of Calcium Rich Foods**

Table XI shows the consumption pattern of calcium rich foods among the selected women.

**TABLE - XI**

**CONSUMPTION OF CALCIUM RICH FOODS BY THE SELECTED WOMEN**

**(N=2230)**

| Calcium Rich Foods* | Daily | | Weekly once | | Monthly once | | Rarely | | Not at all | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| **Milk products** | 312 | 14 | 134 | 6 | 602 | 27 | 602 | 27 | 580 | 26 |
| **Non vegetarian foods** | 139 | 6 | 1405 | 63 | 379 | 17 | 174 | 8 | 139 | 6 |
| **Ragi** | - | - | 268 | 12 | 401 | 18 | 647 | 29 | 914 | 41 |
| **Soya products** | - | - | 580 | 26 | 914 | 41 | 290 | 13 | 446 | 20 |
| **Greens** | 89 | 4 | 491 | 22 | 847 | 38 | 647 | 29 | 156 | 7 |
| **Lime** | - | - | 178 | 8 | 446 | 20 | 714 | 32 | 892 | 40 |
| **Ladies finger** | - | - | 1048 | 47 | 357 | 16 | 602 | 27 | 223 | 10 |
| **Sundakkai** | - | - | 513 | 23 | 424 | 19 | 624 | 28 | 669 | 30 |
| **Almonds / Nuts** | - | | 268 | 12 | 468 | 21 | 558 | 25 | 937 | 42 |
| **Sesame seeds** | - | - | 580 | 26 | 825 | 37 | 401 | 18 | 424 | 19 |

* Multiple response

In common, the use of calcium rich foods was found to be inadequate among the study group. Majority of the respondents consumed some foods daily namely milk products (14%), non vegetarian foods (6%) and greens (4%). Common calcium rich foods consumed weekly once included milk products (6%), non vegetarian foods (63%), ragi (12%), soya products (26%), greens (22%), lime (8%), ladies finger ( 47%), sundakkai (23%), almonds / nuts ( 12%), and sesame seeds (26%).

According to Young *et al.,* (2015), adequate calcium intake and including calcium rich food sources for instance dairy products, seaweeds, fish, beans and fruits can help in preventing osteoporosis in later life which facilitate calcium absorption among postmenopausal women. It was reported that as calcium intake improved it helped in Bone Mineral Density increase and the threat of osteoporosis occurrence was reduced when more than one serving of milk or dairy products was consumed and serum 25 (OH) vitamin D level was maintained in the normal range.

Heaney (2000), stated that consumption of calcium rich foods and supplements is useful against defeat of bone mass with age. In spite of the calcium supplements, calcium rich foods have generally been recommended since the supplements can worsen heart disease among menopausal women and can cause side effects like digestive problems, vomiting and diarrhoea (Bolland *et al.*, 2008).

**d. Consumption of Vitamin D Rich Foods**

Table XII depicts the consumption pattern of vitamin D rich foods among the selected women.

**TABLE - XII**

**CONSUMPTION OF VITAMIN D RICH FOODS BY THE SELECTED WOMEN**

**(N=2230)**

| Vitamin D Rich Foods* | Daily | | Weekly once | | Monthly once | | Rarely | | Not at all | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| **Milk products** | 312 | 14 | 134 | 6 | 602 | 27 | 602 | 27 | 580 | 26 |
| **Sea foods** | - | - | 468 | 21 | 737 | 33 | 646 | 29 | 379 | 17 |
| **Liver** | - | - | - | - | 714 | 32 | 624 | 28 | 892 | 40 |
| **Egg** | - | - | 981 | 44 | 424 | 19 | 602 | 27 | 223 | 10 |

* Multiple response

The common vitamin D rich foods like milk products, sea foods, liver and egg were consumed either weekly or monthly once and sometimes rarely by the selected women. Research reports by Lips (2001) and Heaney (2004) revealed that persistent vitamin D inadequacy among adults may cause secondary hyperparathyroidism, enhanced bone turnover and bone loss, greater risk of fragility, fracture and infrequently hypocalcemic tetany.

According to Holick (2006) vitamin D dietary sources are inadequate and gaining a sufficient amount from normal diet is often challenging for many people whose diet does not contain the foods that are rich in vitamin D by nature. Studies by Leboff (1999) have linked vitamin D shortage in diet to the greater risk of hip and other non vertebral fractures. A few clinical trials and observational studies have reported that dietary vitamin D supplementation lowers fracture risk when given jointly with calcium (Larsen, *et al.,* 2004).

**e. Consumption of Fast Foods**

Table XIII presents the details regarding the consumption of fast foods by the selected women.

**TABLE - XIII**

**CONSUMPTION OF FAST FOODS BY THE SELECTED WOMEN**

| Consumption | No. | | | | Per cent | | | |
|---|---|---|---|---|---|---|---|---|
| **Occasionally** | 1338 | | | | 60 | | | |
| **Daily** | 557 | | | | 25 | | | |
| **Not at all** | 335 | | | | 15 | | | |
| **Total** | **2230** | | | | **100** | | | |
| **Type of Fast Foods*** | **Daily** | | **Weekly once** | | **Monthly once** | | **Rarely** | |
| | **No.** | **%** | **No.** | **%** | **No.** | **%** | **No.** | **%** |
| **Chat items** | 401 | 18 | 937 | 42 | 557 | 25 | 335 | 15 |
| **Bakery products** | 70 | 3 | 870 | 39 | 580 | 26 | 710 | 32 |
| **Spicy foods** | 112 | 5 | 648 | 29 | 472 | 21 | 998 | 45 |
| **Chinese foods** | - | - | 602 | 27 | 847 | 38 | 781 | 35 |
| **Fried items** | 134 | 6 | 937 | 42 | 691 | 31 | 468 | 21 |

* Multiple response

It is seen that 60 per cent of the selected women consumed fast foods occasionally followed by 25 per cent consuming them daily and a least percentage (15%) had restricted consumption of fast foods. Majority of them took chat items, bakery products and fried items weekly once. Chinese foods were consumed by a majority of women monthly once. Consumption of chat items, spicy foods and fried items daily was also found among a low percentage of women.

Goyal and Singh (2007) reported that young Indian consumers have eagerness for visiting fast food outlets for enjoyment and change for taste and quality. They preferred home food of primary choice better than food served at fast food outlets. Feeley *et al*., (2009), reported that 30 per cent of their study groups had fast food consumption by 5 to 7 times per week and another 20 per cent included it 2 to 4 times per week.

**f. Consumption of Nutrient / Food Supplements**

Table XIV depicts the consumption of nutrient and food supplements by the selected women

**TABLE - XIV**

**CONSUMPTION OF NUTRIENT / FOOD SUPPLEMENT BY THE SELECTED WOMEN**

| Form of Supplements * | Regularly | | Occasionally | |
|---|---|---|---|---|
| | No. | Per cent | No. | Per cent |
| **Multi vitamin supplements** | 156 | 7 | 267 | 12 |
| **Calcium supplements** | 89 | 4 | - | - |
| **Commercial food supplements** | 245 | 11 | 335 | 15 |
| **Dietary supplement (Home made)** | 357 | 16 | 401 | 18 |

* Multiple response

It is seen from the table that about 7 per cent of the selected women were consuming multi vitamin supplements, 4 per cent taking calcium supplements, 11 per cent consuming commercial food supplements whereas a majority of 16

per cent consumed dietary supplements made at home related to their health. Among the selected women some of them were consuming the supplements occasionally to enhance their health.

### 3. LIFE STYLE PATTERN OF THE SELECTED WOMEN

The life style pattern of the selected women is discussed under the following headings.

#### a. Beverage Consumption

Table XV illustrates the details on consumption of beverages by the selected women.

**TABLE - XV**

**CONSUMPTION OF BEVERAGES BY THE SELECTED WOMEN**

| Beverage Consumption | Coffee | | Tea | | Health drinks | | Total | |
|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % |
| **Yes** | 1025 | 46 | 870 | 39 | 335 | 15 | 2230 | 100 |
| **Total** | **1025** | **46** | **870** | **39** | **335** | **15** | **2230** | **100** |
| **Beverage Quantity** | **No.** | **%** | **No.** | **%** | **No.** | **%** | **Total** | |
| | | | | | | | **No.** | **%** |
| **< 2 cups** | 201 | 9 | 156 | 7 | 245 | 11 | 602 | 27 |
| **2 - 4 cups** | 490 | 22 | 424 | 19 | 90 | 4 | 1004 | 45 |
| **> 4 cups** | 334 | 15 | 290 | 13 | - | - | 624 | 28 |
| **Total** | **1025** | **46** | **870** | **39** | **335** | **15** | **2230** | **100** |

It is seen from the table that all the selected women had the habit of consuming beverages either as coffee, tea or health drinks. A majority of 46 per cent of the selected women preferred coffee, whereas 39 per cent preferred tea and only 15 per cent consumed health drinks.

As stated by Soo (2014), coffee might be the most commonly consumed beverage in the world. Research studies have revealed that coffee consumption

is notably associated with increased threat of osteoporosis and osteoporotic fractures (Higdon and Frei, 2006).

About 45 per cent being the majority consumed 2 to 4 cups of the specific beverage every day and nearly 27 per cent of women consumed less than 2 cups of beverage. It is observed that more than 4 cups of coffee or tea was consumed by 28 per cent of women.

It is clear that coffee and tea consumption to some extent was more among the selected women which needs proper guidance to change the habit. Caffeine reflects negative effect to bone concentration by an escalating calcium loss and it has been reported that intake of caffeine increases the excretion of calcium in urine (Lioyd, 2008). Hallstrom *et al.,* (2006) reported that a daily intake of 330 mg of caffeine, equal to 4 cups (600 ml) of coffee, or more may be associated with an increased risk of osteoporotic fractures, particularly in women with a low intake of calcium. To reduce the osteoporosis risk, adequate calcium and vitamin D intake, as well as moderate coffee consumption up to 3 cups per day is recommended mostly for older adults (Hallstrom *et al.,* 2013).

**b. Chewing Habits**

The details on chewing of betel leaves, pan supari or tobacco by the selected women are given in Table XVI.

**TABLE - XVI**

**CHEWING HABITS OF THE SELECTED WOMEN**

| Chewing Habits | Betel leaves and Chunna | | Pan / Supari / Tobacco | | None | | Total | |
|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % |
| **Total** | 401 | 18 | 335 | 15 | 1494 | 67 | 2230 | **100** |
| **Duration of Chewing Habits** | | | | | | | | |
| **Daily** | 48 | 12 | 60 | 18 | - | - | 108 | 15 |
| **Weekly once** | 64 | 16 | 91 | 27 | - | - | 155 | 21 |
| **Rarely** | 289 | 72 | 184 | 55 | - | - | 473 | 64 |
| **Total** | **401** | **100** | **335** | **100** | - | - | **736** | **100** |

With regard to chewing, a majority of 67 per cent of the selected women did not have the chewing habit and a minority of 33 per cent preferred chewing betel leaves, pan masala, supari and tobacco. Among them, a majority of 64 per cent rarely had the habit of chewing and a minority of 15 per cent preferred chewing daily. Chewing of betel nut is a habit that impacts the oral cavity (www.dimensionsofdentalhygiene.com). Tung *et al*., (2004) stated that consumption of betel nuts could slow or elevate the heart rate and might change the effects of drugs that slow the heart, for instance beta blockers and calcium channel blockers.

Fast changes in the diet and lifestyle patterns boost up tobacco consumption which appeared to be decisively linked with mortality owing to cardiovascular as well as cancer in the middle income category (Singh *et al*., 2007). For two decades, pan masala (a powdered chewing mixture) has been in abundant use in India amongst non-smokers as well as smokers (Kumar and Saiyed, 1999).

**c. Exercise, Yoga and Meditation Practices**

Exercise, yoga and meditation practices of the selected women are presented in Table XVII.

**TABLE - XVII**

**EXERCISE, YOGA AND MEDITATION PRACTICES OF THE SELECTED WOMEN**

| Type of Exercise | No. | Per cent |
|---|---|---|
| **No Exercise** | 1360 | 61 |
| **Mild** | 535 | 24 |
| **Moderate** | 335 | 15 |
| **Total** | **2230** | **100** |
| **Yoga / Meditation** | **No.** | **Per cent** |
| **Yes** | 268 | 12 |
| **No Yoga / Meditation** | 1962 | 88 |
| **Total** | **2230** | **100** |

From the table it is inferred that 61 per cent of the selected women did not have the habit of doing any exercise. Twenty four per cent of the selected women performed mild exercise whereas 15 per cent indulged in moderate exercise. Mostly exercise means walking for short distance or long distance for them. Among the selected women a greater percentage (86%) did not have the habit of doing any yoga or meditation and only a minority (12%) practised yoga or meditation.

As stated by Kruk (2007) physical activity reduces chronic diseases such as osteoporosis, cardiovascular disease, diabetes, cancer, obesity, stress and depression. It has been seen in many situations that exercise is the single best way to strengthen the bones, slow or avoid problems relating to joints, muscles and bones and moderate exercise program facilitate to uphold potency and flexibility.

Exercise is significant for well-built muscles and bones. As age increases, the muscle power declines, but studies report that when people exercise they are stronger and leaner compared to others of same age group. Exercise may help kids lower their risk of chronic pain in the future. Exercise is very vital for slowing the sequence of osteoporosis and extremely important for reducing the threat of falling, which causes fractures (Ishikawa *et al.*, 2013).

Yoga therapy provides additional benefits to cardiovascular endurance, inflammatory markers and flexibility (Pullen *et al.,* 2010). Physical activity duration showed significant positive association with BMD values at all sites (Moushira, 2014). The present findings revealed that the selected women need to be stressed on the importance of yoga or exercise to avoid chronic diseases in future.

**d. Sleep Pattern**

Table XVIII illustrates the sleep pattern of the selected women.

**TABLE - XVIII**

**SLEEP PATTERN OF THE SELECTED WOMEN**

| Duration of sleep | No. | Per cent |
|---|---|---|
| **< 6 hours** | 670 | 30 |
| **6 – 8 hours** | 1369 | 61 |
| **> 8 hours** | 191 | 9 |
| **Total** | **2230** | **100** |

From the table on sleep pattern it is seen that 61 per cent being the majority of the selected women had 6 to 8 hours of sleep which is a desirable practice. Only 30 per cent women had less than 6 hours and a minority (9%) slept more than 8 hours per day. Adequate sleep will enhance healthy living and prevent onset of diseases.

**e. Details on Stress**

The details on stress among the selected women is shown in Table XIX.

**TABLE - XIX**

**DETAILS ON STRESS AMONG THE SELECTED WOMEN**

| Details | No. | Per cent |
|---|---|---|
| **Relaxed life style** | 379 | 17 |
| **Familial stress** | 825 | 37 |
| **Occupational stress** | 558 | 25 |
| **Other reasons** | 468 | 21 |
| **Total** | **2230** | **100** |

It is clear that among the selected women, a majority of 37 per cent expressed that they had stress due to their family members, followed by 25 per cent with occupational stress. Nearly 21 per cent expressed that they had stress due to various other reasons. It is interesting to observe that 17 per cent of the selected women were leading a relaxed and stress free life.

Chronic stressors may accelerate risk of the age related diseases. Women in modern era will be able to lead a happy and harmonious life even amidst stressful conditions by adopting coping strategies such as habitual exercise, adequate diet and sleep, relaxation techniques along with effective management skills (Jeyagowri and Pallavi, 2009).

According to Anuradha, e*t al*., (2011), occupational stress, excessive salt intake, consumption of coffee, pan chewing and smoking were the important contributors for the occurrence of hypertension. Mental stress showed to influence osteopenia and body mass though the causal relationships between perceived stress, obesity and Hypothalamic Pituitary Adrenal axis (HPA) purpose remain to be revealed (Anilkumar and Suresh, 2011).

**f. Leisure Time Activities**

Leisure time activities of the selected women are given in Table XX.

**TABLE XX**

**LEISURE TIME ACTIVITIES OF THE SELECTED WOMEN**

| Leisure Time Activities | No. | Per cent |
|---|---|---|
| **Watching television** | 1405 | 63 |
| **Hearing music** | 268 | 12 |
| **Reading books** | 178 | 8 |
| **Outdoor visit / Shopping** | 201 | 9 |
| **Others** | 178 | 8 |
| **Total** | **2230** | **100** |

It is obvious from the table that among the selected women, a majority (63%) of them were engaged in watching television, followed by hearing music (12%). Others included outdoor activities and shopping (9%) and reading books (8%) and other activities (8%) by a minimum number of selected women during their leisure time.

**B. Nutritional, Health Status and Bone Health Profile of Selected Women**

**1. Anthropometric measurements of the selected women**

**a. Height of the selected women**

The mean height of the selected women is given in Table XXI and Figure 4.

**TABLE - XXI**

**HEIGHT OF THE SELECTED WOMEN**

| Height (cm) | No. | Per cent | ICMR (2010) | Mean ± SD |
|---|---|---|---|---|
| **< 150** | 379 | 17 | Reference 161 cm | 159.41±9.10 |
| **151 - 160** | 757 | 34 | | |
| **161 - 170** | 825 | 37 | | |
| **> 171** | 269 | 12 | | |
| **Total** | **2230** | **100** | | |

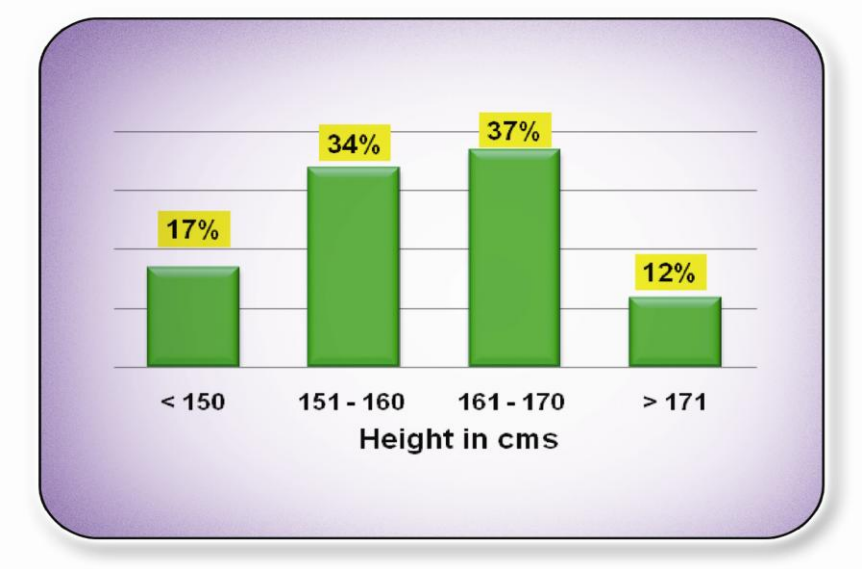



**FIGURE 4 - HEIGHT OF THE SELECTED WOMEN**

It is seen from the table that a majority of 37 per cent of the selected women were in between the normal height of 161 cm to 170 cm, followed by 34 per cent between 151 cm to 160 cm. Among the selected women 17 per cent of them were less than 150 cm and a least of 12 per cent of them were above 171 cm of height.

ICMR (2010) has suggested 161 cm as the reference height for Indian women. The mean height of the selected women is found to be 159.41 cm which is nearly 2 cm less than the ICMR reference value.

**b. Weight of the selected women**

The mean weight of the selected women is given in Table XXII and Figure 5.

**TABLE - XXII**

**WEIGHT OF THE SELECTED WOMEN**

| Weight (kg) | No. | Per cent | ICMR (2010) | Mean ± SD |
|---|---|---|---|---|
| **< 50** | 758 | 34 | Reference 56 kg | 56.91±10.65 |
| **51 - 60** | 624 | 28 | | |
| **61 - 70** | 513 | 23 | | |
| **> 71** | 335 | 15 | | |
| **Total** | **2230** | **100** | | |

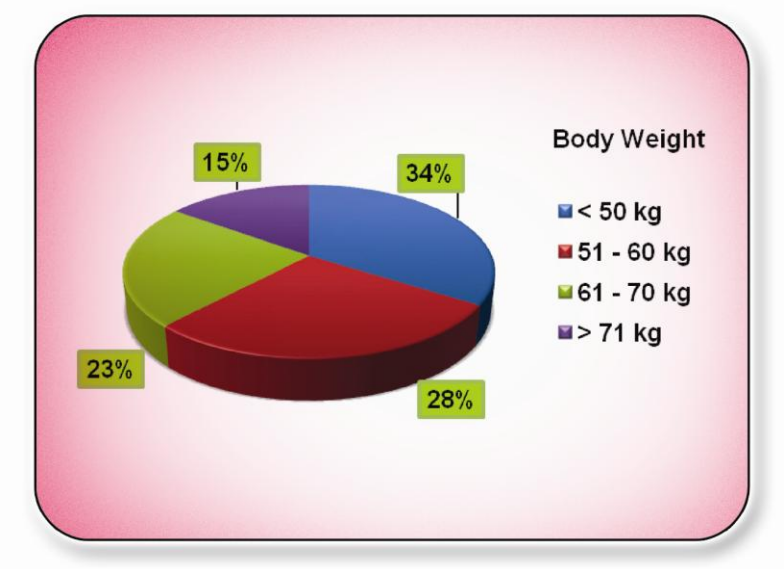



**FIGURE 5 - WEIGHT OF THE SELECTED WOMEN**

With regard to the weight of the selected women, it is seen that a majority of 34 per cent of the selected women weighed less than 50 kg followed by 28 per cent between 51 kg to 60 kg. It is discouraging to observe that 23 per cent of women weighed between 61 kg to 70 kg and 15 per cent of them above 71 kg.

ICMR (2010) has suggested an ideal body weight of 56 kg for Indian women whereas the mean of the selected women of the present study was 56.91 kg weight which is slightly higher than the reference value. Research studies by Reid (2002), reflect a constructive association between bone mass and body size. According to Carney (2007), with increasing age and lack of physical activity the risk of osteoporosis extends.

**c. Body Mass Index (BMI) of the selected women**

The Body Mass Index of the selected women is given in Table XXIII and Figure 6.

**TABLE - XXIII**

**BODY MASS INDEX (BMI) OF THE SELECTED WOMEN**

| BMI (Kg/ $m^2$) range* | Category | No. | Per cent | Mean ± SD |
|---|---|---|---|---|
| **< 18.5** | Under weight | 891 | 40 | 21.9±5.3 |
| **18.5 to 24.9** | Normal | 736 | 33 | |
| **25.0 to 29.9** | Over weight | 271 | 12 | |
| **> 30** | Obese | 332 | 15 | |
| **Total** | **-** | **2230** | **100** | |

*****WHO (2011)

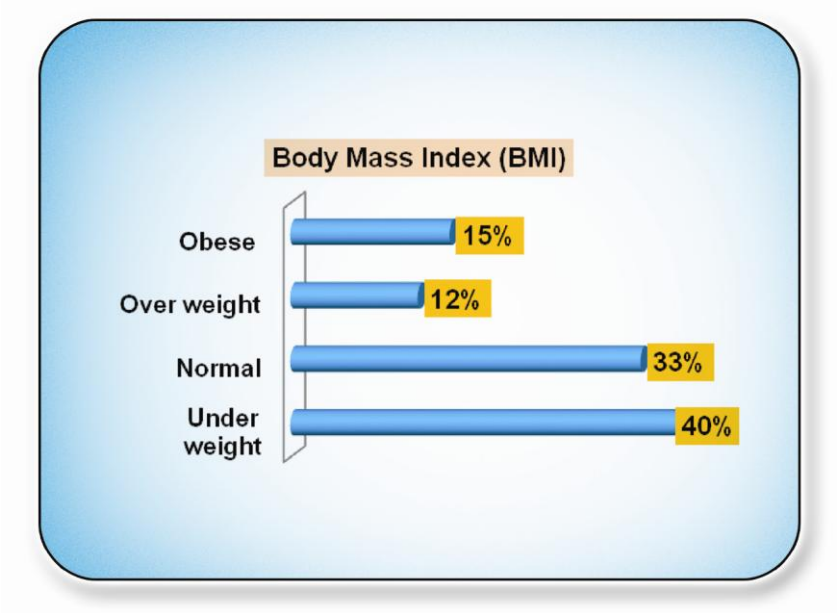



**FIGURE 6 - BODY MASS INDEX (BMI) OF THE SELECTED WOMEN**

The study findings revealed that only 33 per cent of the selected women had normal BMI as suggested by WHO (2011). A majority of 40 per cent of the selected women had BMI below the normal level of <18.5 revealing the poor nutritional status of the surveyed women. Among the selected women 15 per cent were categorized as obese and 12 per cent remained over weight.

The mean body mass index of the selected women of the present study was 21.9 which is categorized within the normal range of 18.5 to 24.9 $kg/m^2$ recommended by WHO (2011). Research studies by De (2005), illustrated that low Body Mass Index is associated with increasing bone loss at forearm. Body Mass Index and body weight were linked with the fracture risk free of common fracture (Biplob and Brajanath, 2014).

**d. Waist to Hip Ratio (WHR) of the selected women**

The Waist to Hip Ratio of the selected women is given in Table XXIV and Figure 7.

**TABLE - XXIV**

**WAIST TO HIP RATIO OF THE SELECTED WOMEN**

| WHR * | Category | No. | Per cent | Mean ± SD |
|---|---|---|---|---|
| **≤ 0.80** | Normal | 1159 | 52 | 0.81±0.82 |
| **0.81 – 0.85** | Moderate Risk | 603 | 27 | |
| **> 0.85** | High risk | 468 | 21 | |
| **Total** | | **2230** | **100** | |

* WHO (2009)

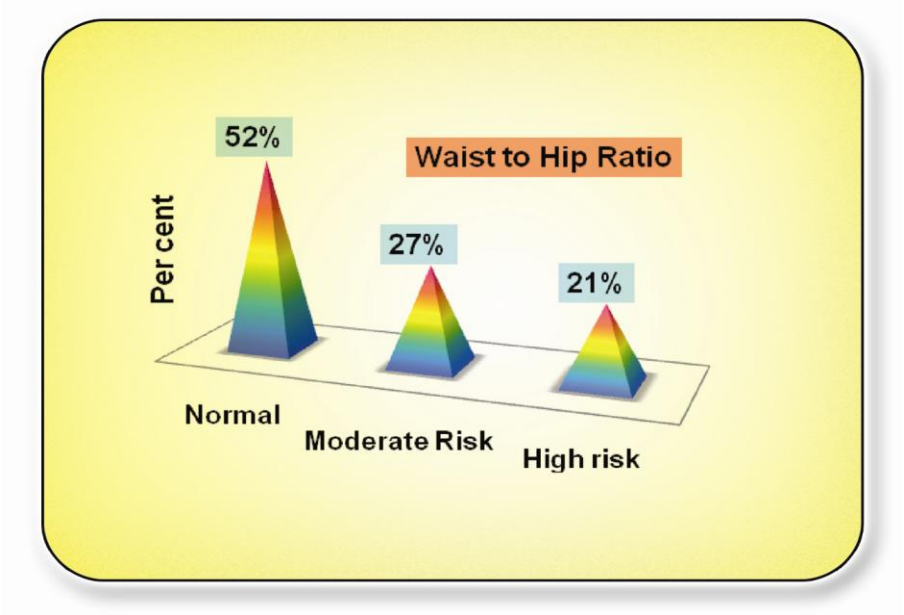



**FIGURE 7 - WAIST TO HIP RATIO OF THE SELECTED WOMEN**

It is observed from the table that among the study population a majority of 52 per cent of women had a normal Waist to Hip Ratio less than 0.8. About 27 per cent of the selected women were at moderate risk with values between 0.81 to 0.85 and a least of 21 per cent had the Waist to Hip Ratio above 0.85 being at high risk. The mean Waist to Hip Ratio was found to be 0.81 which falls under the category of 0.81 to 0.85 as moderate risk suggested by WHO (2009).

According to Kim *et al.,* (2004), the visceral fat act as an important factor in the expansion of metabolic and cardiovascular problems and the elevated visceral fat thickness was associated with cardiovascular and metabolic disease.

## 2. Bone Mineral Density of the selected women

Measuring the bone density is a key tool in the diagnosis of bone health and osteoporosis. The details regarding Bone Mineral Density values are presented in Table XXV and Figure 8.

**TABLE – XXV**

**BONE MINERAL DENSITY (BMD) OF THE SELECTED WOMEN**

| BMD Classification | Criteria 't' value Score | No. | Per cent | Mean ± SD |
|---|---|---|---|---|
| **Normal** | ≥ -1.0 | 1193 | 53 | -1.09±1.58 |
| **Osteopenia** | -1.0 to -2.5 | 642 | 29 | |
| **Osteoporosis** | ≤ -2.5 | 395 | 18 | |
| **Total** | | **2230** | **100** | |

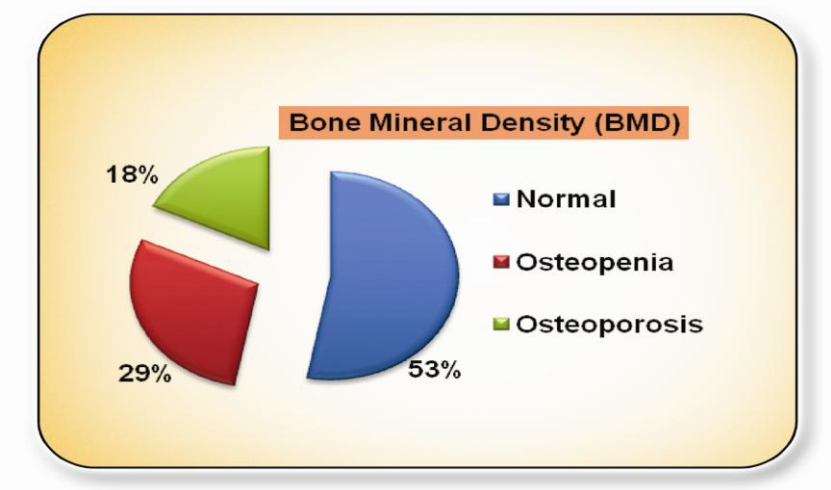



**FIGURE 8 - BONE MINERAL DENSITY OF THE SELECTED WOMEN**

The present study revealed that among the selected women, nearly 53 per cent had normal BMD scores. Among the remaining women a majority of 29 per cent suffered from osteopenia with T scores -1.0 to 2.5 and 18 per cent had osteoporosis with T scores ≤ - 2.5. The mean BMD score of the selected women was found to be -1.09 which comes in the category of -1.0 to -2.5 designated as osteopenia. This finding highlights the fact that nowadays more women are predisposed to osteopenia and osteoporosis.

It is very common that among women the thickness of the bone (BMD) normally start reducing through the fourth decade of life. However, normal decline in bone density is hastened through the menopausal transform. In view of the fact that mutually age and the hormonal change owing to the menopause change continue together to cause osteoporosis (Siris, 2006).

### 3. Clinical Problems of the Selected Women

The clinical problems expressed by the selected women are presented in Table XXVI.

**TABLE – XXVI**
**CLINICAL PROBLEMS OF THE SELECTED WOMEN (N=2230)**

| Signs and Symptoms * | No. | Per cent |
|---|---|---|
| **Sleep disturbance** | 1427 | 64 |
| **Inability to work** | 1404 | 63 |
| **Mental tension** | 1360 | 61 |
| **Tiredness** | 1204 | 54 |
| **Shoulder pain** | 1182 | 53 |
| **Hair fall** | 1159 | 52 |
| **Back pain** | 1137 | 51 |
| **Joint pain** | 981 | 44 |
| **Lack of appetite** | 914 | 41 |
| **Headache** | 825 | 37 |
| **Vision problems** | 782 | 35 |
| **Heart burn** | 736 | 33 |
| **Sweating** | 691 | 31 |
| **Dental problems** | 692 | 31 |
| **Breathlessness** | 624 | 28 |
| **Oedema** | 602 | 27 |
| **Pale / Dry face** | 580 | 26 |
| **Wheezing / Asthma** | 491 | 22 |
| **Skin problems / Allergy** | 468 | 21 |
| **Giddiness / Shivering** | 468 | 21 |
| **Ulcer** | 423 | 19 |
| **Palpitation** | 401 | 18 |

* Multiple Response

It is seen from the table that among the selected population of 2230 women a majority of them expressed that they had sleep disturbance (64%), inability to work (63%), mental tension (61%), followed by tiredness (54%), shoulder pain (53%), hair fall (52%) back pain(51% ) and joint pain (44%). In addition lack of appetite (41%), headache (37%), vision problem (35%), heart burn (33%), sweating (31%) and dental problems (31%) were also reported by more percentage of the selected women.

Other clinical problems such as breathlessness (28%), oedema (27%), pale and dry face (26%), wheezing and asthma (22%), giddiness and shivering (21%), skin problems and allergy (21%), ulcer (19%) and palpitation (18%) were also expressed by a lesser percentage of the selected women.

In general, a majority of the women had widespread clinical problems such as sleep disturbance, lack of ability to work, mental stress, tiredness, shoulder pain, back pain and joint pain revealing the fact that the selected women are not leading a healthy life. This finding reveals the need for proper dietary treatment and lifestyle modification.

**4. Biophysical and Biochemical Assessment of the Selected Women**

**a. Blood Pressure among the Selected Women**

The details related to blood pressure values of the selected women based on JNC (2004) classification is given in Table XXVII.

**TABLE – XXVII**
**CLASSIFICATION OF SELECTED WOMEN BASED ON JNC (2004) HYPERTENSION GUIDELINES**

| Category | Range (mm Hg) | No. | Per cent |
|---|---|---|---|
| **Low Blood Pressure** | **SBP < 120 DBP < 80** | 401 | 18 |
| **Normal Blood Pressure** | **SBP 120 DBP 80** | 779 | 35 |
| **Pre-hypertension** | **SBP 120 – 139 DBP 80 - 89** | 646 | 29 |
| **Stage I - Hypertension** | **SBP 140 – 159 DBP 90 - 99** | 269 | 12 |
| **Stage II - Hypertension** | **SBP ≥ 160 DBP ≥ 100** | 135 | 6 |
| **Total** | | **2230** | **100** |

SBP- Systolic Blood Pressure DBP- Diastolic Blood Pressure

From the table it is seen that among the selected women, a majority of 35 per cent had normal blood pressure, followed by 29 per cent under the category of pre-hypertension, 18 per cent had low blood pressure and 18 per cent had elevated blood pressure (12 % of them under stage I and 6 % under stage II).

It is observed that two thirds of the selected women suffered from either low blood pressure (18 %) or high blood pressure (47 %) emphasising the need for proper education on dietary practices and lifestyle changes.

### b. Biochemical Assessment of the Selected Women

#### i. Blood Haemoglobin Levels of the Selected Women

Table XXVIII and Figure 9 show the details related to blood haemoglobin levels and anaemia prevalence among the selected women.

**TABLE – XXVIII**

**BLOOD HAEMOGLOBIN LEVELS OF THE SELECTED WOMEN**

| Category | Haemoglobin levels* (g / dl) | No. | Per cent |
|---|---|---|---|
| **Normal** | **≥ 12** | 691 | 31 |
| **Mild Anaemia** | **10– 11.9** | 312 | 14 |
| **Moderate Anaemia** | **7– 9.9** | 1026 | 46 |
| **Severe Anaemia** | **< 7** | 201 | 9 |
| **Total** | | **2230** | **100** |

* Krause (2008)

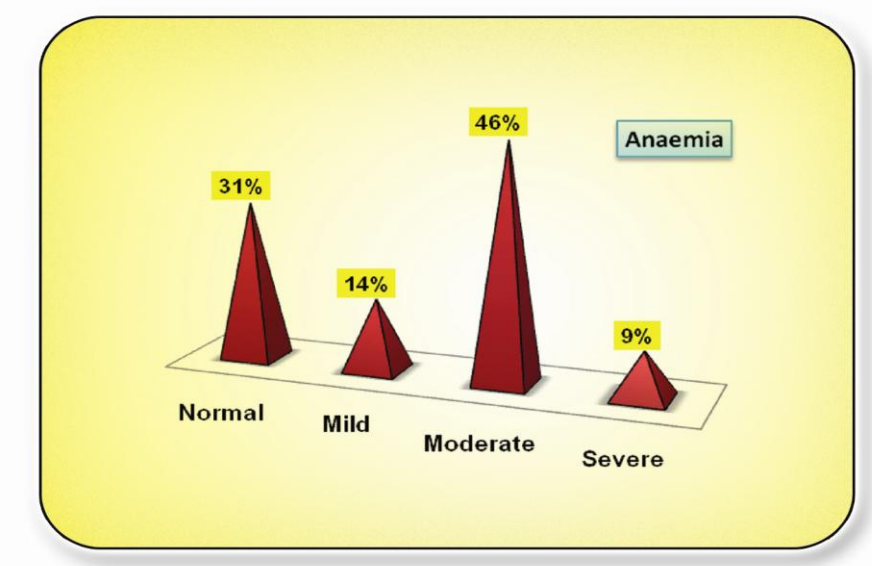



**FIGURE 9 – ANAEMIA PREVALENCE AMONG THE SELECTED WOMEN**

It is evident from the table that among the selected women only 31 per cent had normal haemoglobin levels with a value more than 12 g / dl. Moderate anaemia was found among 46 per cent of the selected women which is of great concern and needs proper efforts to overcome anaemia among them. It is encouraging to note that severe anaemia was found only among 9 per cent of women under study. In general, two thirds of the selected women were suffering from some form of anaemia.

**ii. Serum Calcium Levels of the Selected Women**

The serum calcium levels of the selected subsample of women is presented in Table XXIX and Figure 10.

**TABLE – XXIX**

**SERUM CALCIUM LEVELS OF THE SELECTED WOMEN (N = 245)**

| Serum Calcium levels* (mg / dl) | Category | No. | Per cent |
|---|---|---|---|
| **Very low** | **7.0 - 8.0** | 22 | 9 |
| **Low** | **8.0 - 9.0** | 132 | 54 |
| **Normal** | **9.0 - 10.6** | 57 | 23 |
| **High** | **10.6 - 11.0** | 34 | 14 |
| **Total** | | **245** | **100** |

* Institute of Medicine (2010)

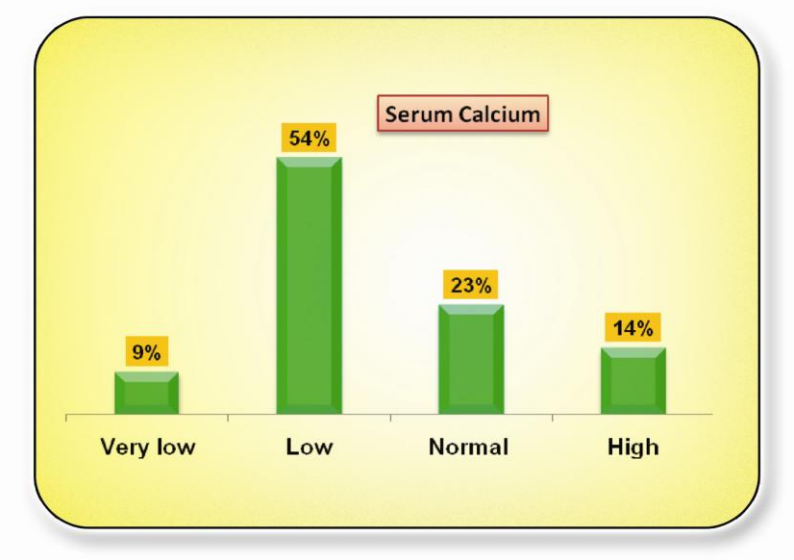



**FIGURE 10 - SERUM CALCIUM LEVELS OF THE SELECTED WOMEN**

It is obvious from the table that a majority of 54 per cent of the selected women had low serum calcium levels with values of 8 to 9 mg / dl. Only 23 per cent of women had normal serum calcium levels between 9 to 10.6 mg / dl. Nearly 14 per cent of the selected women had elevated serum calcium levels more than 10.6 mg / dl where as 9 per cent had very low serum calcium levels with a value of 7 to 8 mg / dl.

In general only one fourth of women had normal calcium levels, whereas a majority had low or very low calcium levels.

### 5. Dietary Assessment of the Selected Women

The mean food intake of the selected women of moderate activity was assessed and compared with the ICMR Recommended Allowances given in Table XXX and Figure 11.

**TABLE – XXX**

**MEAN FOOD INTAKE OF THE SELECTED WOMEN**

**(N = 120)**

| Food Groups | RDA (g)* | Actual Intake (g) | Excess / deficit (%) |
|---|---|---|---|
| **Cereals** | 270 | 240 | -11.1 |
| **Pulses** | 60 | 65 | 8.3 |
| **Roots and Tubers** | 200 | 75 | -62.5 |
| **Green Leafy Vegetables** | 100 | 70 | -30.0 |
| **Other Vegetables** | 200 | 120 | -40.0 |
| **Fruits** | 100 | 65 | -35.0 |
| **Milk and Milk products** | 300 | 160 | -46.7 |
| **Fats and Oils** | 20 | 30 | 50.0 |
| **Sugar and Jaggery** | 20 | 35 | 75.0 |
| **Nuts and Oilseeds** | 25 | 15 | -40.0 |

* RDA (ICMR, 2010)

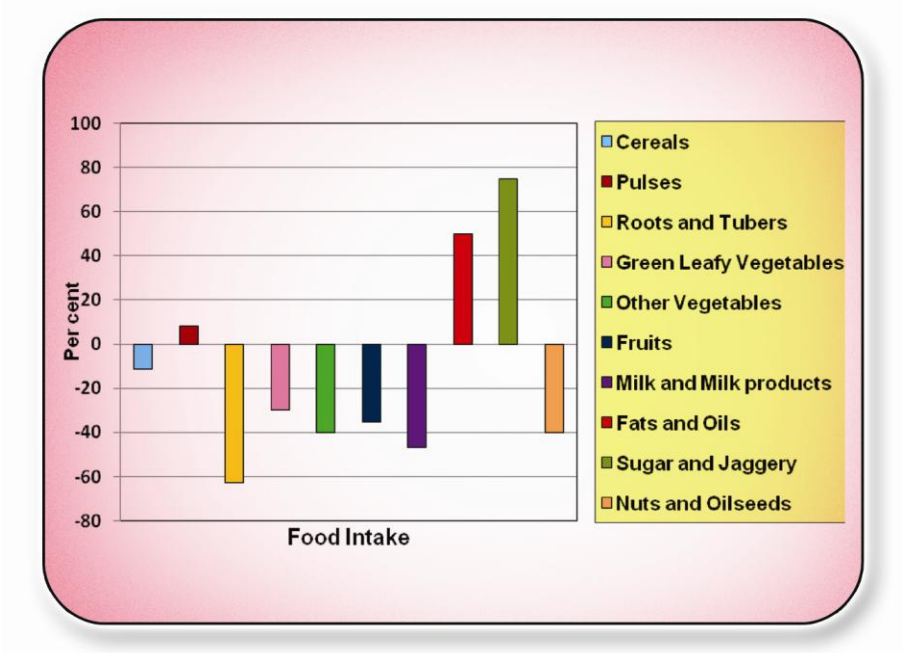



**FIGURE 11 – EXCESS OR DEFICIT PERCENTAGE OF FOOD INTAKE**

With regard to the mean food intake of selected women, it is observed that the cereal consumption was deficit by 11.1 per cent when compared with the RDA. The pulse consumption was found to be slightly excess by 8.3 per cent. In the case of roots and tubers, green leafy vegetables and other vegetables the consumption was found to be deficit by 62.5, 30 and 40 per cent respectively compared to the RDA. Concerning the fruit consumption, the selected women were having a deficit intake by 35 per cent.

With reference to the milk and milk product consumption by the selected women it was deficit by 46.7 per cent. The fat intake was found to be 50 per cent in excess of the RDA among the selected women. The sugar and jaggery consumption was 75 per cent in excess of the RDA. Excess of fat and sugar consumption may increase energy intake predisposing for obesity and other associated complications. The nut and oilseeds consumption was less than the RDA by 40 per cent among the selected women.

In the current trends diverse dietary evaluation techniques are available to raise the awareness pertaining to the diet and disease correlation. The individual food intake fact affords information on food and nutrient intake, consumption practices and dietary quality. One of the significant role of the dietary assessment is to offer data on average nutrient intakes of the study population (ICMR, 2013).

### 6. Mean Nutrient Intake of the Selected Women

The mean nutrient intake details of the selected women doing moderate activity is given in Table XXXI and Figure 12.

**TABLE – XXXI**

**MEAN NUTRIENT INTAKE OF THE SELECTED WOMEN (N = 120)**

| Nutrients | RDA * | Mean Intake | Excess / deficit (%) |
|---|---|---|---|
| **Energy (Kcal)** | 2230 | 1860 | -16.6 |
| **Protein (g)** | 55 | 62 | 12.7 |
| **Fat (g)** | 25 | 36 | 44.0 |
| **Calcium (mg)** | 600 | 440 | -26.7 |
| **Iron (mg)** | 21 | 17 | -19.0 |
| **Beta Carotene (mcg)** | 4800 | 3570 | -25.6 |
| **Vitamin C (mg)** | 40 | 27 | -32.5 |
| **Thiamine (mg)** | 1.1 | 1.0 | -9.0 |
| **Riboflavin (mg)** | 1.3 | 1.2 | -7.7 |
| **Niacin (mg)** | 14 | 11 | -21.4 |
| **Fibre (g)** | 40 | 19 | -52.5 |

* RDA (ICMR, 2010)

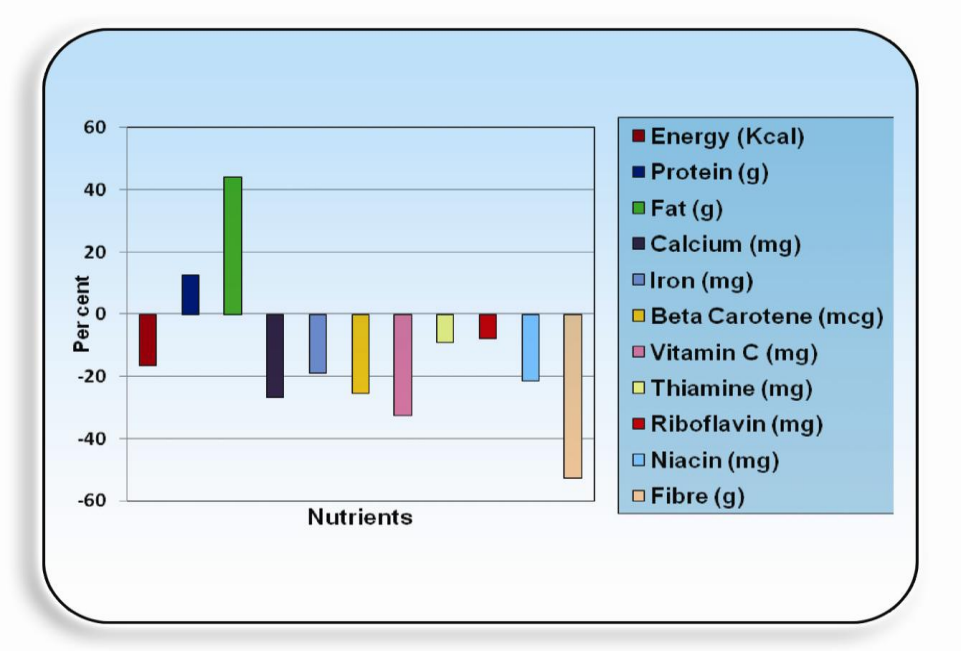



**FIGURE 12 – EXCESS OR DEFICIT PERCENTAGE OF NUTRIENT INTAKE**

From the table it is observed that the energy intake of the selected women was less than the RDA by 16.6 per cent. Protein consumption was in excess by 12.7 per cent.

It is seen that fat consumption by the selected women was in excess by 44 per cent than the RDA which may be a point of concern. There was a deficit intake of calcium by 26.7 per cent among the selected women leading to poor bone health. This is also reflected in the low serum calcium levels of majority of women. The iron consumption was less than the RDA by 19 per cent relating to anaemia prevalence among women.

With regard to beta carotene and vitamin C intake among the selected women a deficit of 25.6 and 32.5 per cent respectively was observed. Thiamine, riboflavin and niacin intake was deficit by 9.0, 7.7 and 21.4 per cent respectively than the RDA among the selected women. With reference to fibre intake there was an inadequacy of 52.5 per cent highlighting the need for adequate intake of fibre to lead a healthy life.

## 6. Reproductive History of the Selected Women

### a. Age of Menarche and Menopause of the Selected Women

Table XXXII shows the details on the age of menarche and menopause of the selected women.

**TABLE – XXXII**

**Age at Menarche and Menopause of the Selected Women**

| Particulars | No. | Per cent |
|---|---|---|
| **Age at Menarche (Yrs)** | | |
| **< 13** | 579 | 26 |
| **13 - 14** | 1406 | 63 |
| **> 15** | 245 | 11 |
| **Total** | **2230** | **100** |

| | | |
|---|---|---|
| **Menstruation Cycle** | | |
| **Having menstruation cycle** | 1404 | 63 |
| **Postmenopausal women** | 826 | 37 |
| **Total** | **2230** | **100** |
| **Interval of Menstruation (Days)** | | |
| **< 25** | 337 | 24 |
| **26 – 35** | 688 | 49 |
| **> 35** | 379 | 27 |
| **Total** | **1404** | **100** |
| **Age of Menopause (Yrs)** | | |
| **40 - 45** | 264 | 32 |
| **46 - 55** | 405 | 49 |
| **> 55** | 157 | 19 |
| **Total** | **826** | **100** |

With regard to the age of menarche among the selected women, a majority of 63 per cent had their puberty between the age of 13 to 14 years, followed by 26 per cent below the age of 13 years. Only 11 per cent attained puberty beyond 15 years of age. This is a normal observation that the menarcheal age is 13 – 14 years.

Among the selected women a majority of 63 per cent were having the regular menstrual cycle and a minimum of 37 per cent were in the post menopausal category.

With regard to the interval of menstruation, a maximum of 49 per cent of the selected women had their periods between 26 to 35 days. Nearly 27 per cent had an interval of more than 35 days and a least of 24 per cent had their periods within a short period of 25 days.

It is observed that a majority of 49 per cent of the selected women had their menopause between the age of 46 to 55 years. About 32 per cent had their menopause between 40 to 45 years which shows the early onset of menopause among many women. A less percentage (19 %) of women attained menopause after 55 years which is a normal observation.

**b. Age of Marriage and Pregnancy details of the Selected Women**

The details on the age of marriage and pregnancy details of the selected women is given in Table XXXIII.

**TABLE – XXXIII**

**AGE OF MARRIAGE AND PREGNANCY DETAILS**

**OF THE SELECTED WOMEN**

| Particulars | No. | Per cent |
|---|---|---|
| **Age of Marriage (Yrs)** | | |
| **< 25** | 834 | 42 |
| **26 - 29** | 973 | 49 |
| **> 30** | 178 | 9 |
| **Total** | **1985** | **100** |
| **Age at First Pregnancy (Yrs)** | | |
| **< 23** | 615 | 31 |
| **24 - 29** | 1271 | 64 |
| **> 30** | 99 | 5 |
| **Number of Children** | | |
| **1 – 2** | 1112 | 56 |
| **3** | 834 | 42 |
| **≥ 4** | 39 | 2 |

It is observed from the table that a majority of 49 per cent of the selected women got married between the age of 26 to 29 years, followed by 42 per cent below 25 years and a least of 9 per cent married at 30 years and above.

With regard to the age of first pregnancy, a majority of 64 per cent of the selected women had their pregnancy before the age of 23 years and a minority of 5 per cent had at the age of 30 years and above. A majority of 56 per cent of the selected women had given birth to 1 to 2 children which is the present day trend of single or 2 children. Nearly 42 per cent of women had 3 children and only 2 per cent had 4 children and more.

**c. Health Problems during Menstrual Periods among the Selected Women**

Table XXXIV shows the details of the health problems experienced by the selected women during menstrual periods.

**TABLE – XXXIV**

**HEALTH PROBLEMS DURING MENSTRUAL PERIODS**

**AMONG THE SELECTED WOMEN**

| Particulars | No. | Per cent |
|---|---|---|
| **Sleeplessness** | 871 | 62 |
| **Tension / stress** | 829 | 59 |
| **Physical discomfort** | 814 | 58 |
| **Stomach ache** | 646 | 46 |
| **Emotional disturbance** | 645 | 46 |
| **Excessive bleeding** | 520 | 37 |
| **Fatigue** | 463 | 33 |
| **Migraine** | 407 | 29 |
| **Vomiting** | 393 | 28 |
| **Irregularity of menstruation** | 294 | 21 |

* Multiple Response

It is noted that among the selected women, majority of them had diverse health problems during menstrual periods. The common problems experienced by majority included sleeplessness (62%), tension / stress (59%) and physical discomfort (58%). The other major problems reported were stomach ache (46%), emotional disturbance (46%) and excessive bleeding (37%). Few of the women experienced migraine, fatigue, vomiting and irregularity of menstruation. The findings revealed that most of the women experienced some or other form of health problems during menstrual cycle.

**d. Details of the Problems of Menopause among the Selected Women**

The details of the problems of menopause reported by the selected women is given in Table XXXV.

**TABLE – XXXV**

**PROBLEMS OF MENOPAUSE AMONG THE SELECTED WOMEN**

**(N=826)**

| Particulars | No. | Per cent |
|---|---|---|
| **Weight gain** | 628 | 76 |
| **Irritability** | 595 | 72 |
| **Depression** | 569 | 69 |
| **Breast tenderness** | 537 | 65 |
| **Frequent urination** | 528 | 64 |
| **Joint pain / muscle pain** | 512 | 62 |
| **Migraine** | 470 | 57 |
| **Hair loss** | 454 | 55 |
| **Hot flushes** | 429 | 52 |
| **Mood swings** | 421 | 51 |
| **Insomnia** | 422 | 51 |
| **Palpitation** | 355 | 43 |
| **Dry skin** | 339 | 41 |
| **Facial hair** | 173 | 21 |

* Multiple Response

From the table it is noted that among the 826 women who had attained menopause majority were suffering from some post menopausal problems. The general problems expressed by the selected women included weight gain (76%), irritability (72%), depression (69%), breast tenderness (65%), frequent urination (64%) and joint pain / muscle pain (62%). There were also other problems like migraine (57%), hair loss (55%), hot flushes (52%), mood swings (51%), insomnia (51%), palpitation (43%) and dry skin (41%) experienced by the selected women. Problems during menopause were experienced by many of the selected women.

## C. Formulation and Testing of the Supplements

### 1. Acceptability Scores of the Nutri Mixes

Any food product is to be subjected to sensory evaluation for examining its quality either positively or negatively. According to Costell *et al.,* (2009), the method by which an individual allow or disallow a foodstuff is of multidimensional nature. In a multifaceted food matrix, it is not at all easy to create relationships between the individual chemical stimuli concentration, physiological observation and consumer reaction, all the time.

The developed basic nutri mix and combinations I, II, III and IV were subjected to organoleptic evaluation by a panel of members using the hedonic score card. The mean scores of the developed nutri mixes are illustrated in Table XXXVI and Figure 13.

**TABLE - XXXVI**

**MEAN ACCEPTABILITY SCORES OBTAINED BY THE DEVELOPED NUTRI MIXES**

**(Max. Score = 45)**

| Criteria | Maximum Score | Basic Nutri Mix | NMC I | NMC II | NMC III | NMC IV |
|---|---|---|---|---|---|---|
| **Colour** | 9 | 7.9 | 7.9 | 7.9 | 7.7 | 7.5 |
| **Appearance** | 9 | 7.7 | 7.5 | 7.3 | 7.0 | 6.8 |
| **Texture** | 9 | 8.1 | 7.2 | 7.3 | 7.0 | 7.0 |
| **Taste** | 9 | 7.3 | 7.9 | 7.7 | 7.5 | 7.7 |
| **Flavour** | 9 | 7.5 | 7.7 | 7.5 | 7.5 | 7.3 |
| **Total Score** | **45** | **38.5** | **38.2** | **37.7** | **36.7** | **36.3** |

NMC - Nutri Mix Combination

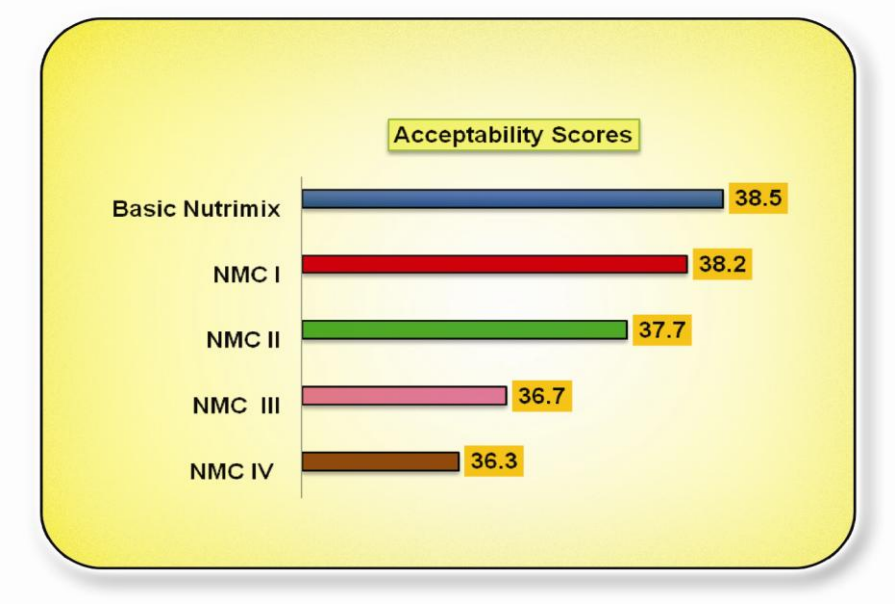



**FIGURE 13 - MEAN ACCEPTABILITY SCORES OF THE DEVELOPED NUTRI MIXES**

With regard to the color criteria the basic nutri mix, combinations I and II scored the maximum score of 7.9 out of 9, followed by nutri mix combination III and IV with a score of 7.7 and 7.5 respectively. It is observed that with regard to appearance, basic nutri mix scored the maximum of 7.7 followed by combinations I, II and III scoring 7.5, 7.3, 7.0 respectively and least score of 6.8 by nutri mix combination IV.

For texture, a maximum score of 8.1 was obtained by basic nutri mix and a minimum of 7.0 was obtained by the two nutri mix combinations III and IV with groundnut. Nutri mix combination I and II with sesame seeds scored 7.2 and 7.3 for texture.

With regard to taste nutri mix I and II scored 7.9 and 7.7 being the maximum which is more than the score of 7.3 got by basic mix. The scores of 7.5 and 7.7 got by nutri mix III and IV were better than the scores of basic mix.

With reference to flavor a maximum of 7.7 was scored by nutri mix I followed by basic nutri mix, nutri mix II and III with 7.5 each and a least score of 7.3 was by nutri mix IV. All the combinations and basic mix were good in terms of flavor.

In general, the overall scores of the developed basic and nutri mix combinations revealed that a maximum score of 38.5 was secured by basic nutri mix followed by nutri mix combination I and II with sesame seeds with a score of 38.5 and 37.7. A minimum score of 36.7 and 36.3 was obtained by nutri mix combination III and IV with ground nuts. All the developed nutri mixes were found to be reasonably acceptable based on scores, however the best two combinations nutri mix I and II with highest score were selected for supplementation study.

**2. Nutrient Content of the Nutri Mixes**

Among the developed five nutri mixes, combinations I and II with sesame seeds were found to be highly acceptable with good acceptability scores and hence they were subjected to nutrient analysis.

Table XXXVII presents the content of proximate principles in the developed nutri mixes.

**TABLE - XXXVII**

**PROXIMATE PRINCIPLES OF THE NUTRI MIXES (100 g)**

| Proximate Principles | Basic Nutri Mix | NMC I | NMC II |
|---|---|---|---|
| **Energy (kcal)** | **336** | **400** | **420** |
| **Carbohydrate (g)** | **53** | **56** | **51** |
| **Protein (g)** | **13.45** | **15.00** | **18.88** |
| **Fat (g)** | **7.68** | **5.50** | **5.85** |
| **Fibre (g)** | **2.78** | **3.07** | **3.08** |
| **Moisture (g)** | **1.80** | **1.70** | **1.63** |
| **Ash (g )** | **3.70** | **3.96** | **3.80** |

NMC - Nutri Mix Combination

With regard to energy, a maximum of 420 kcal per 100 g was found in nutri mix combination II followed by nutri mix combination I with 400 kcal and basic nutri mix had 336 kcal per 100 g. The highest carbohydrate of 56 g per 100g was found in nutri mix combination I, followed by basic nutri mix with 53 g and nutri mix combination II with 51 g per 100 g.

Among the nutri mixes, it is seen that a maximum protein content was found in nutri mix combination II with 18.88 g and a minimum protein content of 13.45 g per 100 g in basic nutri mix. The fat content of the nutri mixes ranged from 5.5 g to 7.68 g per 100 g.

With regard to fibre, a maximum of 3.08 g and 3.07 g per 100 g was found in nutri mix combination II and I respectively and basic nutri mix with 2.78 g per 100 g. The moisture content of the nutri mixes ranged from 1.63 to 1.8g per 100g suitable for good storage.

With regard to ash content, it is observed that among the nutri mixes a maximum of 3.96 g of ash per 100 g was found in nutri mix combination I followed by nutri mix combination II with 3.80 g and basic nutri mix with 3.70g in 100g.

The mineral content of the developed nutri mixes are presented in Table XXXVIII.

**TABLE - XXXVIII**

**MINERAL CONTENT OF THE NUTRI MIXES (100 g)**

| Mineral Content | Basic Nutri Mix | NMC I | NMC II |
|---|---|---|---|
| **Calcium (mg)** | **307** | **455** | **445** |
| **Iron (mg )** | **3.9** | **5.0** | **5.5** |
| **Phosphorus (mg )** | **356** | **350** | **330** |

NMC - Nutri Mix Combination

The minerals namely calcium, iron and phosphorus were analysed in the nutri mixes. With regard to calcium content, it is observed that among the nutri mixes a maximum of 455 mg of calcium per 100 g was found in nutri mix combination I followed by nutri mix combination II with 445 mg and a minimum of 307 mg per 100 g in basic nutri mix. A maximum iron content of 5.5 mg per 100g was found in nutri mix combination II, followed by nutri mix combination I and basic nutri mix with 5 mg and 3.9 mg per 100 g respectively.

The phosphorus content of the nutri mixes ranged between 330 mg to 356 mg per 100 g with a minimum content in nutri mix combination II and maximum content in basic nutri mix.

Table XXXIX presents the vitamin content of the developed nutri mixes.

**TABLE - XXXIX**

**VITAMIN CONTENT OF THE NUTRI MIXES (100g)**

| Vitamin Content | Basic Nutri Mix | NMC I | NMC II |
|---|---|---|---|
| **Vitamin A (mg)** | **ND** | **ND** | **ND** |
| **Vitamin B1 (mg)** | **0.6mg** | **0.7mg** | **0.8mg** |
| **Vitamin B2 (mg)** | **0.3mg** | **0.25mg** | **0.25mg** |
| **Vitamin B3 (mg)** | **6.6mg** | **6.8mg** | **6.6mg** |
| **Vitamin B5 (mg)** | **1.2mg** | **1.1mg** | **1.0mg** |
| **Vitamin B6 (mg)** | **0.2mg** | **0.3mg** | **0.3mg** |
| **Vitamin B9 (mcg)** | **92mcg** | **98mcg** | **97mcg** |
| **Vitamin B12 (mg)** | **ND** | **ND** | **ND** |
| **Vitamin D (mg)** | **ND** | **ND** | **ND** |

NMC - Nutri Mix Combination ND – Not Detected

From the table it is observed that with reference to the vitamin content of the developed mixes, there was not much difference seen among the three mixes. Vitamins namely A, B12 and C were not in the detectable level in the nutri

mixes. With regard to B-complex vitamins content vitamin B1 (thiamin) ranged from 0.6 to 0.8 mg per cent. Vitamin B2 (riboflavin) content ranged from 0.25 to 0.3 mg per cent and vitamin B3 (niacin) content ranged from 6.6 to 6.8 mg per 100 g. Other vitamins like B5 ranged from 1.0 to 1.2 mg, B6 ranged from 0.2 to 0.3 mg and B9 ranged from 92 to 97 mcg per 100 g. Content of B-complex vitamins in the nutri mixes was found to be at a nominal level supporting the content of other nutrients in the mixes.

**3. Shelf life study of the nutri mixes**

The nutri mixes were analysed for Total Bacterial Count (TBC), Total yeast and mould count and shelf life storage up to 90 days and the details are presented in Table XL.

**TABLE – XL**

**MICROBIAL TESTING OF THE SELECTED NUTRI MIXES**

| Criteria | Basic mix | | NMC I | | NMC II | |
|---|---|---|---|---|---|---|
| | Initial 0 day | After 90 days | Initial 0 day | After 90 days | Initial 0 day | After 90 days |
| **Total Bacterial Count (cfu / g)** | Abs | Abs | Abs | Abs | Abs | Abs |
| **Yeast Count** | Abs | Abs | Abs | Abs | Abs | Abs |
| **Mould Count** | Abs | Abs | Abs | Abs | Abs | Abs |

NMC - Nutri Mix Combination Abs - Absent

From the table it is evident that total bacterial count, yeast and mould count of basic mix and nutri mix I and II at the beginning and over a period of three months were found to be nil highlighting the fact that these mixes were found to be safe for storage. The moisture content of these mixes was very low and hence better storage. Though they could be stored safely for 3 months, the nutri mixes were prepared once a week freshly and distributed to the osteopenic women.

**4. Cost of the nutri mixes**

For every supplementation programme the cost of the product should be considered as well as the nutrient composition. The cost of the supplement should be inexpensive and easily accessible to every individual. The cost of the nutri mixes is shown in Table XLI.

**TABLE – XLI**

**COST OF THE NUTRI MIXES**

| Particulars | Basic Nutri Mix (Rs.) | NMC I (Rs.) | NMC II (Rs.) |
|---|---|---|---|
| **Raw materials (Rs.)** | 10.50 | 10.75 | 11.60 |
| **Processing cost (Rs.)** | 0.50 | 0.50 | 0.50 |
| **Packing cost (Rs.)** | 0.50 | 0.50 | 0.50 |
| **Cost per 100g (Rs.)** | 11.50 | 11.75 | 12.60 |
| **Cost of 50 g mix / day (1 serving)** | 5.75 | 5.87 | 6.30 |

NMC - Nutri Mix Combination

It is found from the table that the cost of all the nutri mixes including the raw materials, processing and packing charges ranged from Rs.11.50 to Rs.12.60 per 100g which is very reasonable. Among the nutri mixes, basic nutri mix costed the least of Rs.11.50 per 100g, followed by nutri mix combination I with Rs.11.75 per 100g and the maximum cost was for nutri mix combination II with Rs.12.60 per 100g. The cost of 50 g mix, which is one serving to the selected women ranged from Rs. 5.87 to Rs.6.30 which is considered to be very reasonable and inexpensive. The cost of nutri mixes when compared with other health mixes was very economical and suitable for supplementation programmes.

## D. Impact of the Supplementation Study

### 1. Anthropometric measurements of the selected women

Table XLII and Figure 14 show the details on changes in body weight among the selected women before and after supplementation.

**TABLE – XLII**

**MEAN BODY WEIGHT OF THE SELECTED WOMEN**

**BEFORE AND AFTER SUPPLEMENTATION**

| Groups | Weight (kg) | | Mean Difference |
|---|---|---|---|
| | Before (N = 40) | After (N = 40) | |
| NMC I Group (G1) a | 63.22 ± 2.24 | 60.97 ± 2.06 [b,c] | 2.25* |
| NMC II Group (G2) b | 63.42 ± 2.25 | 61.20 ± 2.07 | 2.22* |
| Control Group (C) c | 62.90 ± 2.73 [a, b] | 63.35 ± 2.52 | 0.45 [NS] |
| SED - 0.52110 | | CD (0.05) - 1.02664 | |

NMC - Nutri Mix Combination * - Significant at 5% level (t<0.05) [NS] – Not significant

Superscripts on means indicate significant difference at 5 % levels

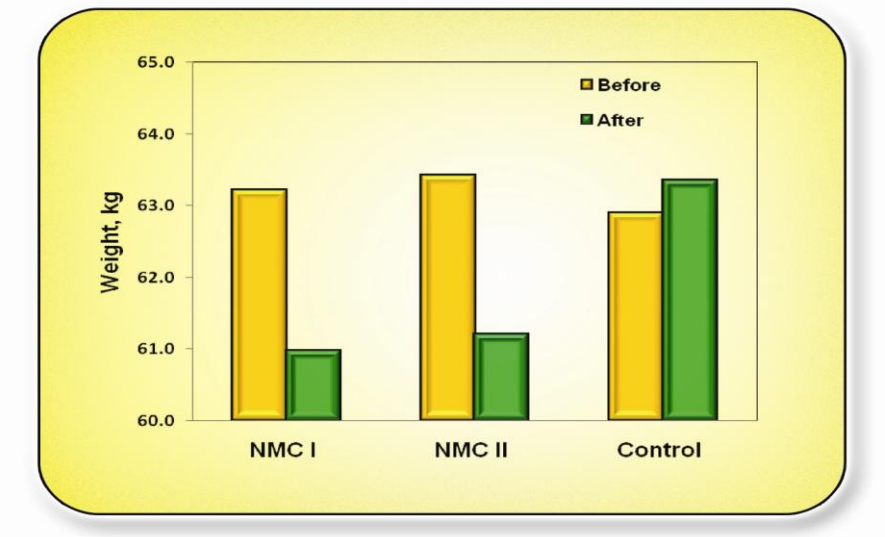



**FIGURE 14 - MEAN BODY WEIGHT OF THE SELECTED WOMEN BEFORE AND AFTER SUPPLEMENTATION**

The mean body weight of women fed with nutri mix I showed a reduction by 2.25 kg over a period of 5 months whereas the group fed with nutri mix II which had a reduction of 2.22 kg. Both the groups exhibited the reduction in weight between initial and final values and the control group showed an increase in weight by 0.45 kg which is not statistically significant.

The comparison of the change in body weight between the experimental groups G1 and G2 showed a statistical significance at 5 per cent level and control group expressed no statistical significance.

**2. Bone Mineral Density of the selected women**

The details of the Bone Mineral Density of the selected women before and after supplementation is presented in Table XLIII and Figure 15.

**TABLE – XLIII**

**MEAN BONE MINERAL DENSITY OF THE SELECTED WOMEN BEFORE AND AFTER SUPPLEMENTATION**

| Groups | BMD T- Score | | Mean Difference |
|---|---|---|---|
| | Before (N = 40) | After (N = 40) | |
| NMC I Group (G1) a | -1.99 ± 0.35 | - 1.52 ± 0.30 | 0.47* |
| NMC II Group (G2) b | -1.77 ± 0.49 | -1.30 ± 0.40 [a,c] | 0.47* |
| Control Group (C) c | -1.71 ± 0.35 [a,b] | -1.88 ± 0.32 | 0.17* |
| | SED - 0.08458 | CD (0.05) - 0.16664 | |

NMC - Nutri Mix Combination * - Significant at 5% level (t<0.05)

Superscripts on means indicate significant difference at 5 % levels

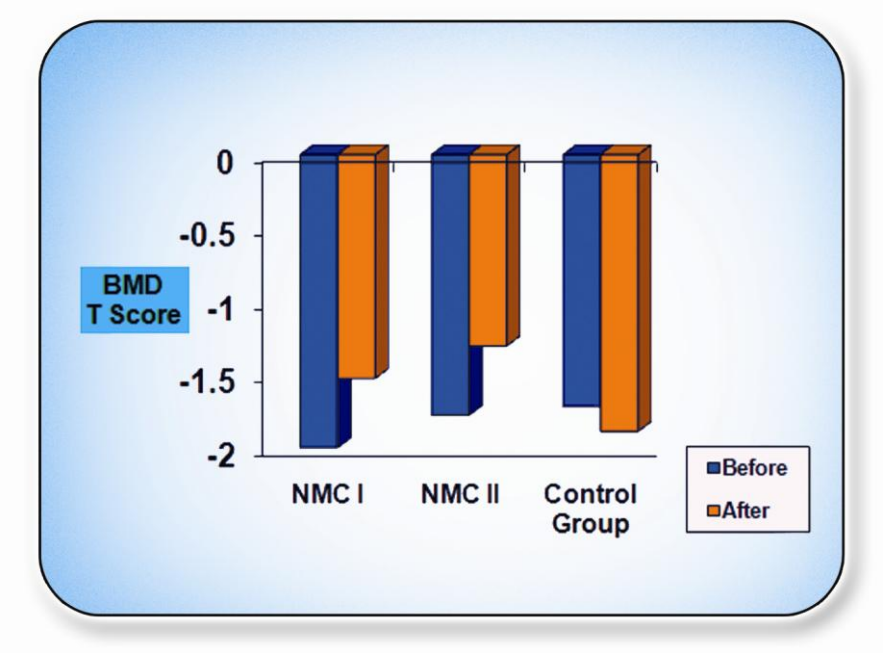



**FIGURE 15 - MEAN BONE MINERAL DENSITY OF THE SELECTED WOMEN BEFORE AND AFTER SUPPLEMENTATION**

The Bone Mineral Density (BMD) was analyzed to find out the effect of the supplement among the selected women before and after the supplementation. The mean BMD score of the group supplemented with nutri mix I and nutri mix II was found to decrease by 0.47 T score each and the differences were found to be statistically significant. The control group without any supplementation showed a slight increase with respect to BMD score. This highlights the fact that nutri mix combination I and II had an effect in improving the BMD scores and thereby bone health of the selected women.

The comparison of the change in Bone Mineral Density between the experimental groups G1, G2 and control groups showed a statistical significance at 5 per cent level.

### 3. Biochemical assessment of the selected women

### a. Mean Haemoglobin Levels

The details of the mean haemoglobin levels of the selected women before and after supplementation is shown in Table XLIV and Figure 16.

**TABLE – XLIV**

**MEAN HAEMOGLOBIN LEVELS OF THE SELECTED WOMEN BEFORE AND AFTER SUPPLEMENTATION**

| Groups | Haemoglobin (g/dl) | | Mean Difference |
|---|---|---|---|
| | Before (N = 40) | After (N = 40) | |
| **NMC I Group (G1) a** | 12.32 ± 0.83 [b,c] | 12.80 ± 0.77 | 0.48* |
| **NMC II Group (G2) b** | 12.87 ± 0.54 | 13.33 ± 0.42 | 0.46* |
| **Control Group (C) c** | 12.56 ± 0.85 | 12.41 ± 0.84 [a,b] | 0.15 [NS] |
| SED - 0.16418 | | CD (0.05) - 0.32345 | |

NMC - Nutri Mix Combination * - Significant at 5% level (t<0.05) [NS] – Not significant

Superscripts on means indicate significant difference at 5 % levels

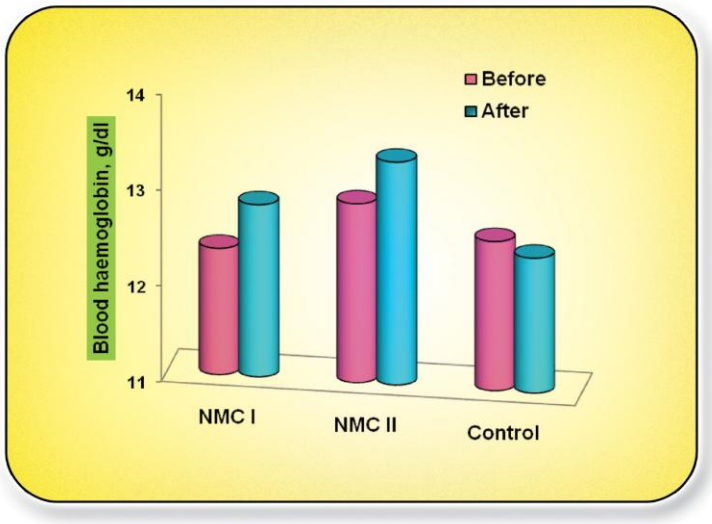



**FIGURE 16 - MEAN HAEMOGLOBIN LEVELS OF THE SELECTED WOMEN BEFORE AND AFTER SUPPLEMENTATION**

From the table it is observed that among the selected women supplemented with nutri mix I and nutri mix II an increase of haemoglobin level

by 0.48 g/dl and 0.46 g/dl respectively after a period of five months supplementation was observed. The control group did not show any difference with respect to haemoglobin levels instead a slight reduction by 0.15 g/dl was observed.

The comparison of the change in blood haemoglobin between the experimental groups G1 and G2 showed a statistical significance at 5 per cent level and the control group without any supplementation showed no statistical significance.

**b. Mean Serum Calcium and Phosphorus Levels**

The changes in mean serum calcium and phosphorus levels of the selected women before and after supplementation is presented in Table XLV and Figure 17 and 18.

**TABLE – XLV**

**MEAN SERUM CALCIUM AND PHOSPHORUS LEVELS OF THE SELECTED WOMEN BEFORE AND AFTER SUPPLEMENTATION**

| Details | Before (N = 40) | After (N = 40) | Mean Difference |
|---|---|---|---|
| **Serum Calcium (mg / dl)** | | | |
| **NMC I Group (G1) a** | 8.96 ± 0.48 | 9.94 ± 0.43 | 0.98 $^{NS}$ |
| **NMC II Group (G2) b** | 8.93 ± 0.54 $^{a, c}$ | 10.05 ± 0.46 | 1.12 $^{NS}$ |
| **Control Group (C) c** | 9.40 ± 0.90 | 9.47 ± 0.83 $^{a,b}$ | 0.07 $^{NS}$ |
| | SED – 1.29723 | CD (0.05) - 2.55573 | |
| **Serum Phosphorus (mg / dl)** | | | |
| **NMC I Group (G1) a** | 2.76 ± 0.43 $^{b,c}$ | 3.85 ± 0.41 | 1.09* |
| **NMC II Group (G2) b** | 2.95 ± 0.44 | 3.66 ± 0.39 | 0.71 $^{NS}$ |
| **Control Group (C) c** | 3.79 ± 0.45 | 3.53 ± 0.46 $^{a,b}$ | 0.26 $^{NS}$ |
| | SED - 0.43057 | CD (0.05) - 0.84828 | |

NMC - Nutri Mix Combination * - Significant at 5% level (t<0.05) $^{NS}$ – Not significant

Superscripts on means indicate significant difference at 5 % levels

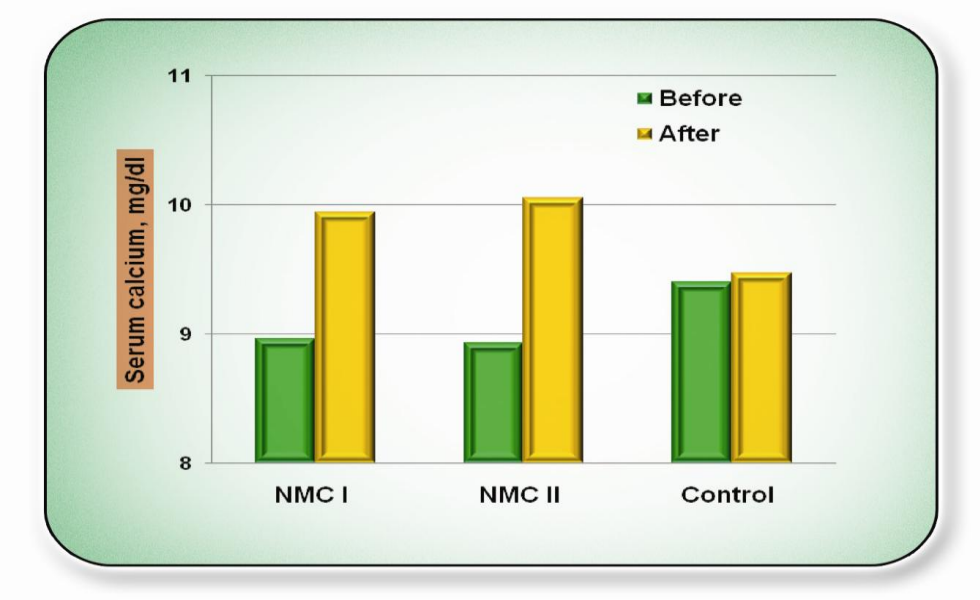



**FIGURE 17 - MEAN SERUM CALCIUM LEVELS OF THE SELECTED WOMEN BEFORE AND AFTER SUPPLEMENTATION**

It is seen from the table that among the selected women the supplementation of nutri mix I and II reflected mean increase in the serum calcium levels of both the selected experimental groups by 0.98mg/dl and 1.12mg / dl respectively. The control group also showed a slight increase by 0.07mg/dl level in serum calcium levels during the study period without any supplementation.

The comparison of the change in serum calcium level between the experimental groups G1, G2 and the control group showed no statistical significance.

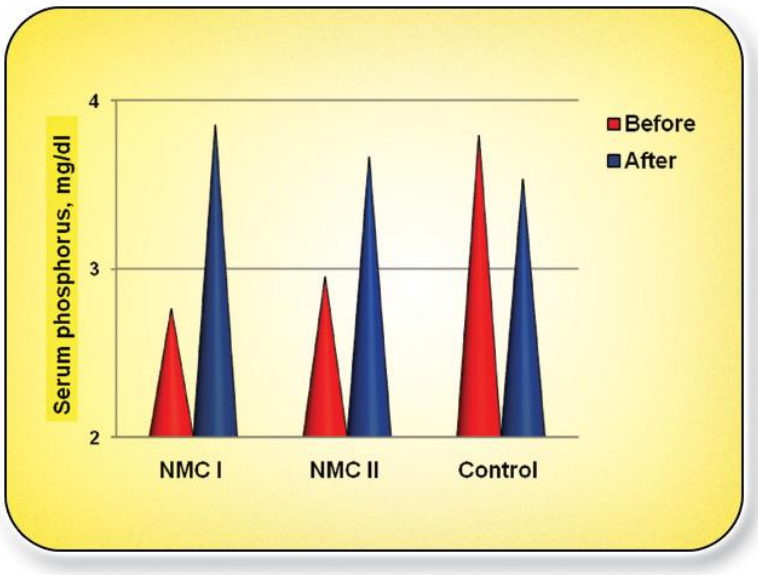



**FIGURE 18 - MEAN SERUM PHOSPHORUS LEVELS OF THE SELECTED WOMEN BEFORE AND AFTER SUPPLEMENTATION**

The mean serum phosphorus levels of the experimental groups increased after the supplementation period. Groups fed with nutri mix I showed an increase in the mean serum phosphorus levels by 1.09 mg/dl whereas nutri mix II group showed an increase of 0.71 mg/dl. The control group showed a reduction in serum phosphorus by 0.26 mg/dl without any supplementation during the study period.

The comparison of the change in serum phosphorus level between the experimental groups G1, showed a statistical significance at 5 per cent level and experimental groups G2 and control group did not have statistical significance.

**c. Mean Fasting and Post Prandial Blood Glucose Levels**

Table XLVI and Figure 19 and 20 shows the details of the mean fasting and post prandial blood glucose levels of the selected women before and after supplementation.

**TABLE – XLVI**

**MEAN FASTING AND POST PRANDIAL BLOOD GLUCOSE LEVELS OF THE SELECTED WOMEN BEFORE AND AFTER SUPPLEMENTATION**

| Details | Before (N = 40) | After (N = 40) | Mean Difference |
|---|---|---|---|
| **Fasting Blood Glucose (mg / dl)** | | | |
| **NMC I Group (G1) a** | 105.47 ± 13.2 | 92.57 ± 9.96 | 12.90* |
| **NMC II Group (G2) b** | 100.95 ± 7.61 [a,c] | 87.05 ± 5.85 [a,c] | 13.90* |
| **Control Group (C) c** | 101.72 ± 14.29 | 103.67 ± 12.03 | 1.95 [NS] |
| | SED - 3.61735 | CD (0.05) - 7.12675 | |
| **Post Prandial Blood Glucose (mg / dl)** | | | |
| **NMC I Group (G1) a** | 194.65 ± 9.41 [b,c] | 182.55 ± 9.86 [b,c] | 12.10* |
| **NMC II Group (G2) b** | 208.70 ± 8.43 | 194.17 ± 9.25 | 14.53* |
| **Control Group (C) c** | 203.15 ±10.51 | 202.35 ±14.66 | 0.80 [NS] |
| | SED – 3.48156 | CD (0.05) - 6.85920 | |

NMC - Nutri Mix Combination * - Significant at 5% level (t<0.05) [NS] – Not significant

Superscripts on means indicate significant difference at 5 % levels

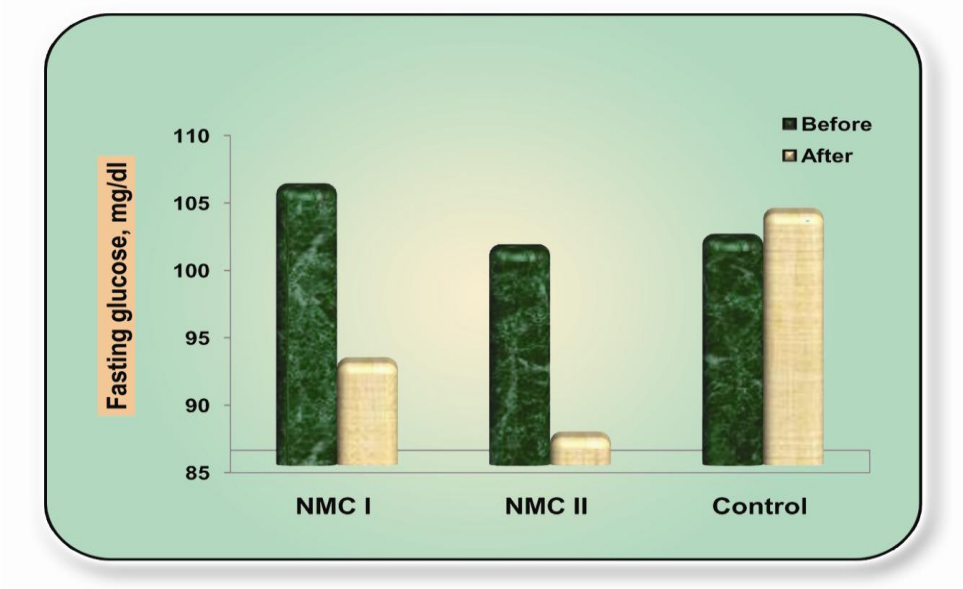



**FIGURE 19 - MEAN FASTING BLOOD GLUCOSE LEVELS OF THE SELECTED WOMEN BEFORE AND AFTER SUPPLEMENTATION**

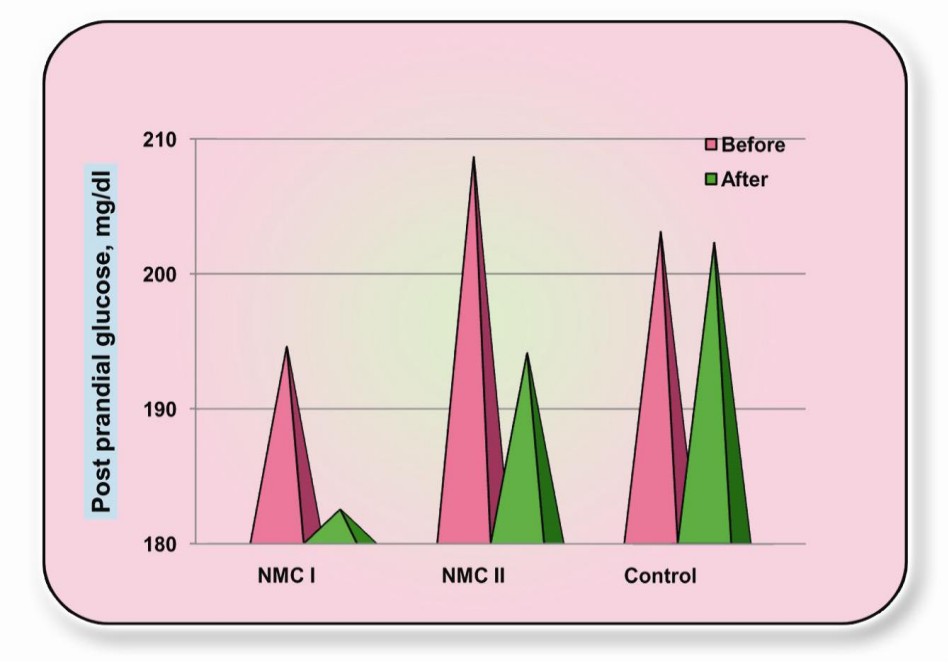



**FIGURE 20 - MEAN POST PRANDIAL BLOOD GLUCOSE LEVELS OF THE SELECTED WOMEN BEFORE AND AFTER SUPPLEMENTATION**

From the table it is observed that among the selected women fed with nutri mix I and II a mean reduction in fasting blood glucose by 12.90mg/dl and 13.90 mg/dl respectively was found. The differences were found to be statistically significant at five per cent level and the slight increase in control group was not statistically significant.

The comparison of the change in fasting blood glucose in experimental groups G1 and G2 is statistically significant at 5 per cent level. The comparison of the change in fasting blood glucose in control group showed no significance.

With regard to the mean post prandial blood glucose it was found that there was a reduction by 12.10 mg/dl and 14.53 mg/dl among the group supplemented with nutri mix combination I and II respectively. The differences were found to be statistically significant at five per cent level. The control group showed a slight reduction in post prandial blood glucose but significant change was observed.

The comparison of the change in post prandial blood glucose among experimental groups G1 and G2 showed a statistical significance at 5 per cent level with the supplementation of the nutri mixes I and II for the experimentation groups whereas the control group showed no statistical significance during the study period.

**d. Mean Total Cholesterol Levels**

The details of the mean total cholesterol levels of the selected women before and after supplementation is presented in Table XLVII and Figure 21.

**TABLE – XLVII**

**MEAN TOTAL CHOLESTEREOL LEVELS OF THE SELECTED WOMEN BEFORE AND AFTER SUPPLEMENTATION**

| Groups | Total Cholesterol (mg / dl) | | Mean Difference |
|---|---|---|---|
| | Before (N = 40) | After (N = 40) | |
| **NMC I Group (G1) a** | 195.25 ± 12.66 | 173.12 ± 9.95 $^{b,c}$ | 22.13 $^{NS}$ |
| **NMC II Group (G2) b** | 201.20 ± 10.24 | 181.67 ± 9.61 | 19.53 $^{NS}$ |
| **Control Group (C) c** | 183.87 ± 8.63 $^{a,b}$ | 181.87 ± 8.88 | 2.00 $^{NS}$ |
| | SED – 23.26092 | CD (0.05) - 45.82759 | |

NMC - Nutri Mix Combination $^{NS}$ – Not significant

Superscripts on means indicate significant difference at 5 % levels

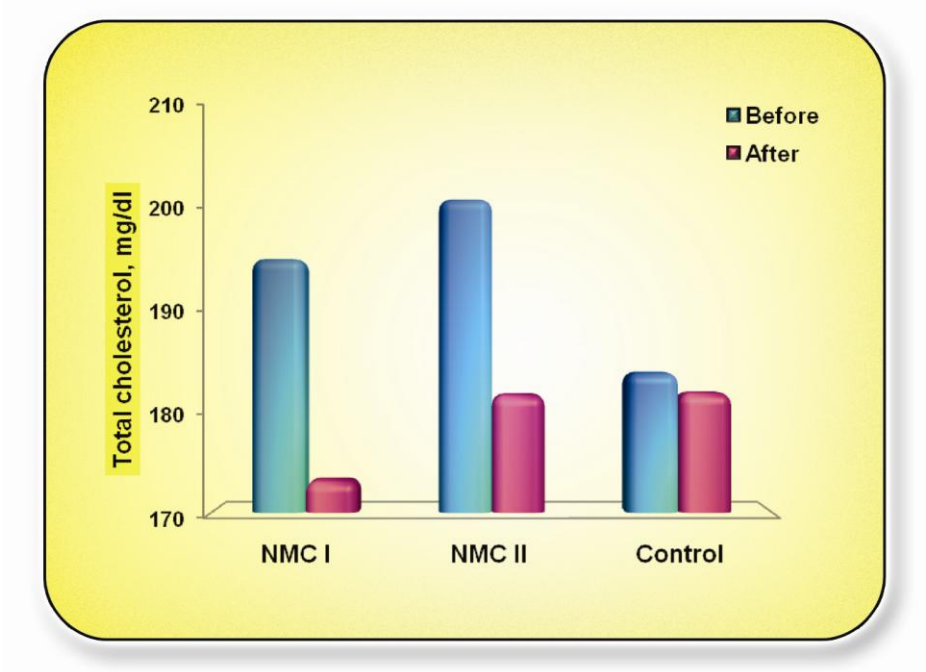



**FIGURE 21 - TOTAL CHOLESTEROL LEVELS OF THE SELECTED WOMEN BEFORE AND AFTER SUPPLEMENTATION**

From the table it is seen that among the selected women fed with nutri mix combination I and II a reduction in the mean total cholesterol levels by 22.13mg/dl and 19.53mg/dl respectively during the supplementation period. The differences in values were not statistically significant. The control group showed a reduction by 2mg/dl in total cholesterol levels which is not statistically significant. Supplementation of nutri mix combination I and II to experimental groups G1 and G2 was helpful in reducing the cholesterol levels among the selected women during the study period.

The comparison of the change in blood cholesterol levels among the experimental groups G1, G2 and control group did not show any statistical significance.

**e. Correlation between Serum Calcium and Selected Parameters**

The details of the correlation between serum calcium and selected parameters is presented in Table XLVIII, Figure 22 and 23.

**TABLE – XLVIII**

**Correlation between serum calcium and selected parameters**

| Parameters | Correlation co-efficient | | | | | |
|---|---|---|---|---|---|---|
| | Nutri Mix I Group | | Nutri Mix II Group | | Control group | |
| | r value | p value | r value | p value | r value | p value |
| **Weight** | 0.033 | 0.839 | 0.060 | 0.712 | 0.059 | 0.718 |
| **Hemoglobin** | 0.308 | 0.053 | -0.029 | 0.858 | 0.146 | 0.370 |
| **Serum phosphorus** | -0.004 | 0.979 | -0.125 | 0.443 | -0.180 | 0.267 |
| **Cholesterol** | 0.115 | 0.480 | 0.125 | 0.443 | -0.048 | 0.768 |

From the table it is observed that a positive correlation existed between serum calcium with other parameters like weight, haemoglobin and cholesterol among the selected women of nutri mix I group. A negative correlation was noted between the serum calcium and serum phosphorus among the selected women.

With regard to nutri mix II group, serum calcium had a positive correlation with parameters such as weight and cholesterol among the selected women. There is a negative correlation between serum calcium and parameters like haemoglobin and serum phosphorus.

Control group without any supplementation showed a positive correlation with parameters such as weight and haemoglobin among the selected women. There is a negative correlation between the serum calcium with serum phosphorus and cholesterol.

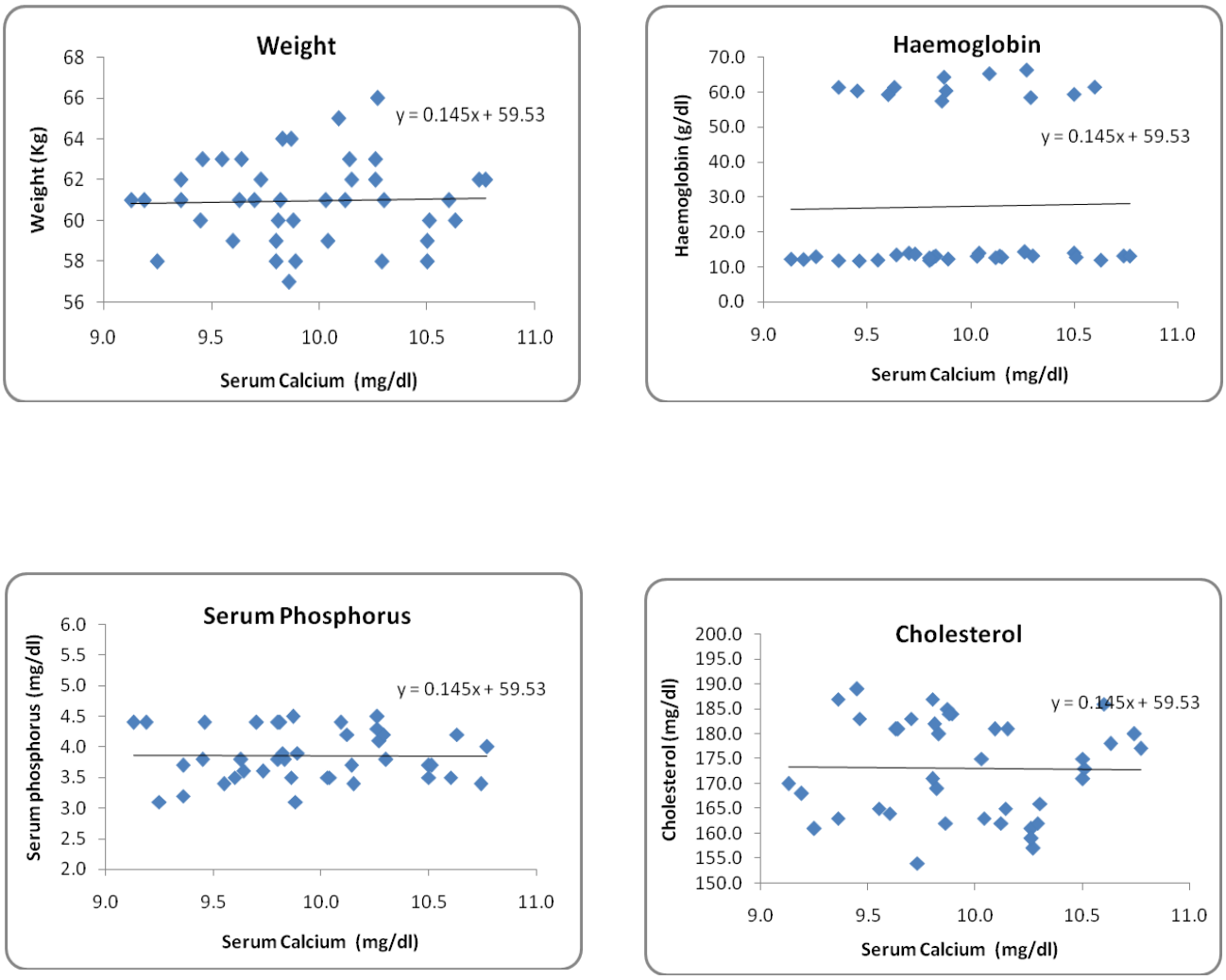
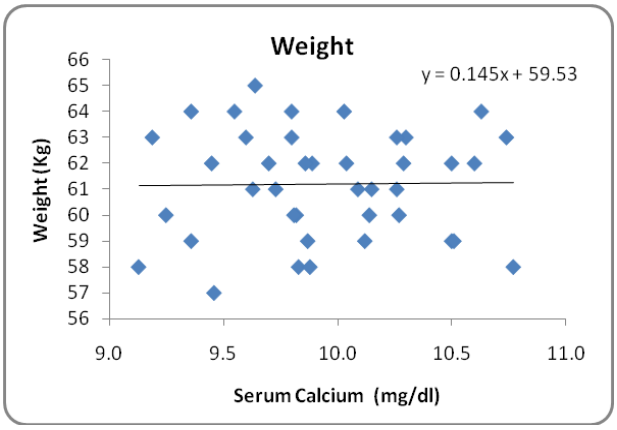
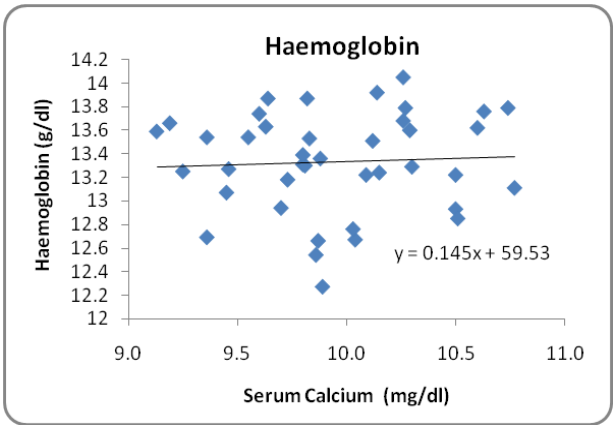
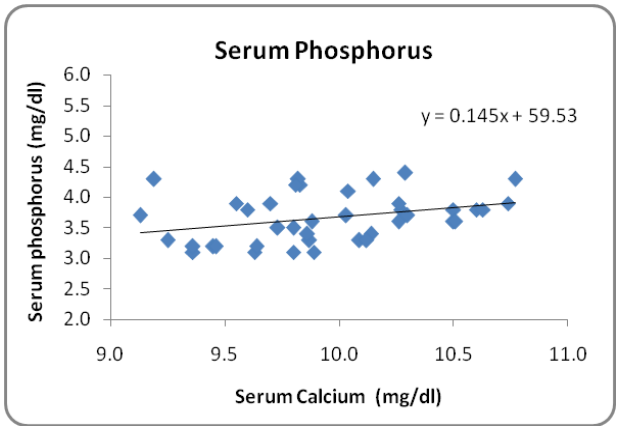



**FIGURE - 22 CORRELATION BETWEEN SERUM CALCIUM AND SELECTED PARAMETERS OF EXPERIMENTAL GROUP G1**



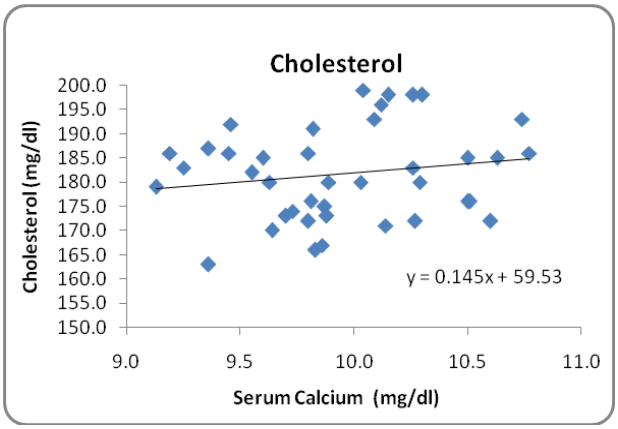




**FIGURE - 23 CORRELATION BETWEEN SERUM CALCIUM AND SELECTED PARAMETERS OF EXPERIMENTAL GROUP G2**

**f. Correlation between Bone Mineral Density (BMD) and Selected Parameters**

The details of the correlation between Bone Mineral Density (BMD) and other parameters is presented in Table XLIX, Figure 24 and 25.

**TABLE – XLIX**

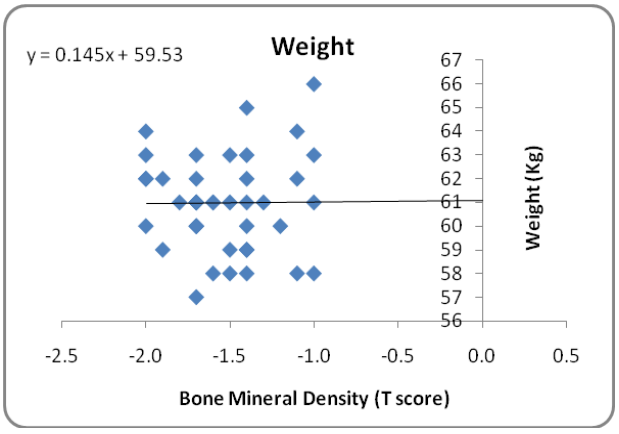
**Correlation between BMD and Selected Parameters**

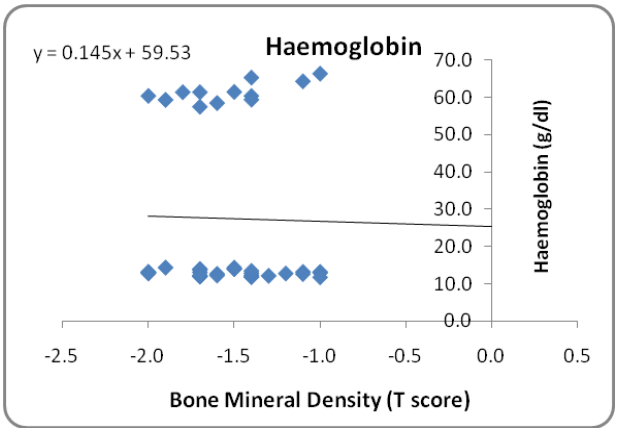
| Parameters | Correlation co-efficient | | | | | |
|---|---|---|---|---|---|---|
| | Nutri Mix I Group (G1) | | Nutri Mix II Group (G2) | | Control Group (C) | |
| | r value | p value | r value | p value | r value | p value |
| **Weight** | 0.011 | 0.946 | -0.168 | 0.301 | -0.103 | 0.467 |
| **Hemoglobin** | -0.290 | 0.070 | -0.002 | 0.952 | -0.010 | 0.089 |
| **Serum phosphorus** | 0.162 | 0.319 | 0.242 | 0.132 | 0.048 | 0.174 |
| **Cholesterol** | 0.093 | 0.570 | 0.186 | 0.251 | -0.021 | 0.314 |

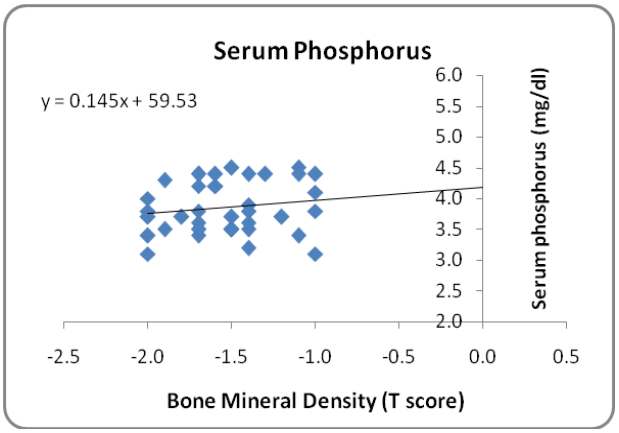
It is observed from the table that a positive correlation was found with regard to Bone Mineral Density (BMD) with other parameters like weight and serum phosphorus among nutri mix I group. A negative correlation was noted between BMD and parameters like haemoglobin and cholesterol.

With regard to nutri mix II group, BMD had a positive correlation with parameters like serum phosphorus and cholesterol. A negative correlation was noted between BMD and parameters like weight and haemoglobin among the selected women.

Control group without any supplementation showed a positive correlation of BMD with serum phosphorus among the selected women. There is a negative correlation between BMD and parameters like weight, haemoglobin and cholesterol.



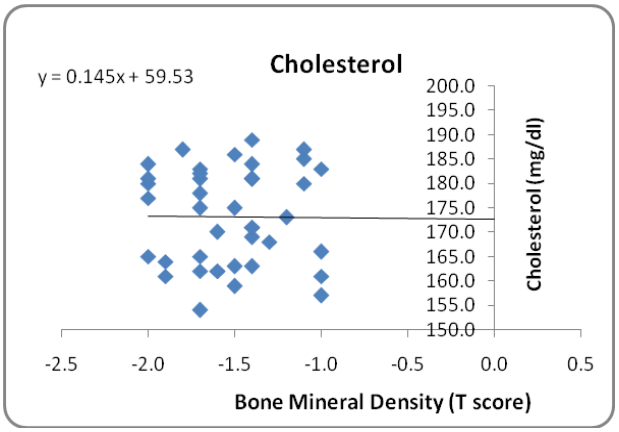




**FIGURE - 24 CORRELATION BETWEEN BMD AND SELECTED PARAMETERS OF EXPERIMENTAL GROUP G1**

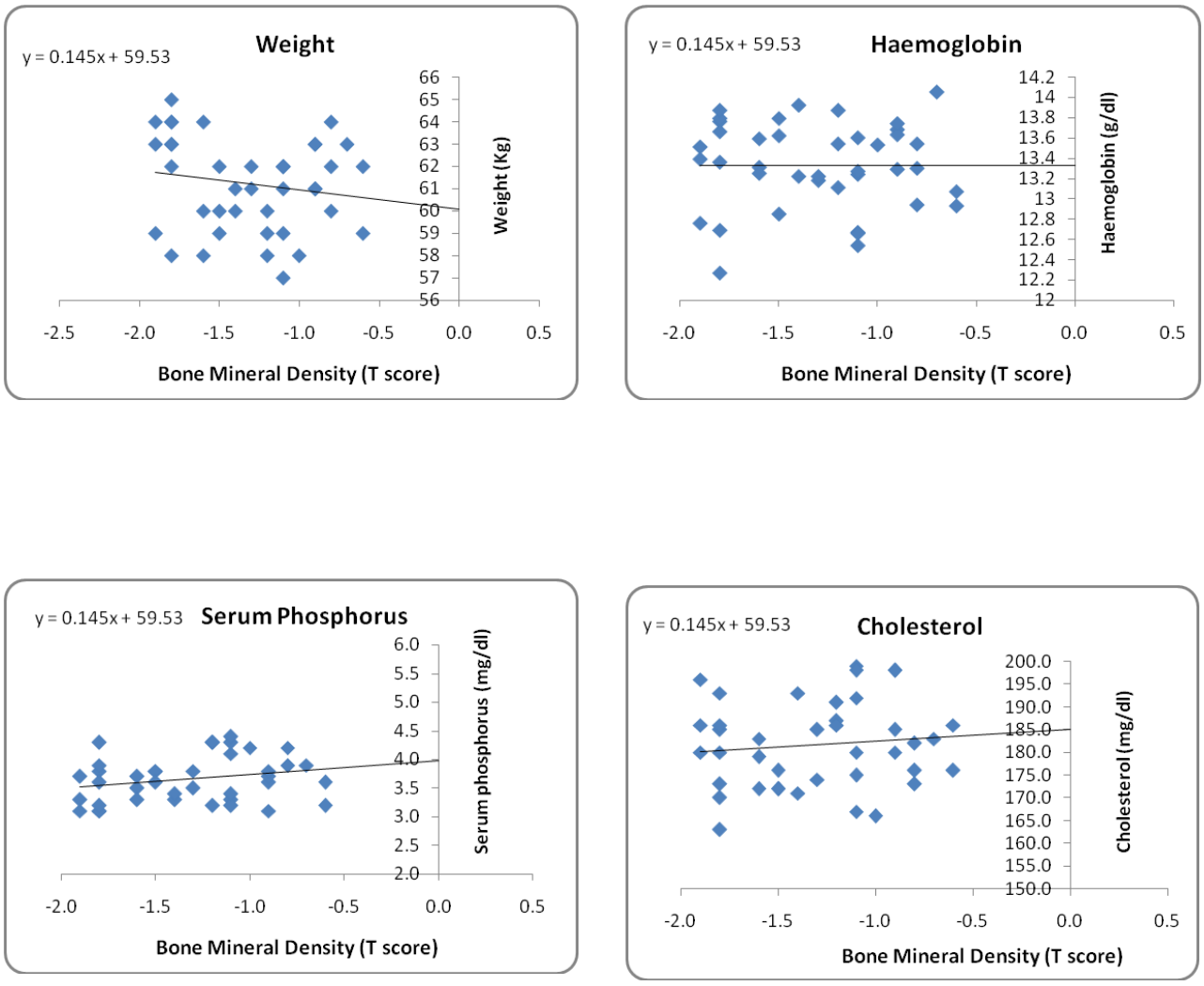



**FIGURE - 25 CORRELATION BETWEEN BMD AND SELECTED PARAMETERS OF EXPERIMENTAL GROUP G2**

## E. Impact of Nutrition Education

### 1. Nutrition knowledge scores of the selected women

Development and assessment of the nutrition education series that value and fabricate the existing skill of participant offer opening for self bound learning and activities and construct social support, social networks and belief among participants while connecting them to the extensive community (Arnold *et al.,* 2001). Nutrition knowledge scores of the selected women was assessed at the initial and final stage of nutrition education. The changes in the Knowledge, Attitude and Practice (KAP) and impact of nutrition education among the selected women is presented in Table L and Figure 26.

**TABLE – L**
**MEAN KAP SCORES OF THE SELECTED WOMEN**
**BEFORE AND AFTER NUTRITION EDUCATION (N = 125)**

**Max. score - 25**

| Particulars | Before | After | Mean Difference | 't' value |
|---|---|---|---|---|
| **Nutrition Education (KAP)** | 8.12 ± 1.61 | 20.40 ± 1.60 | 12.28 | 60.282** |

**- Significant at 1% level (t<0.01)

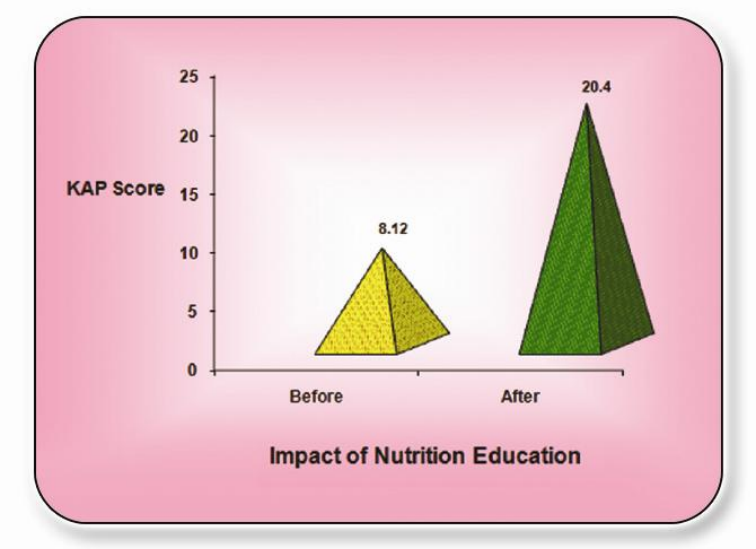



**FIGURE 26 - KAP SCORES OF THE SELECTED WOMEN BEFORE AND AFTER NUTRITION EDUCATION**

Before nutrition education selected women were not aware of the nutrition problems and management of the diseases. Accordingly the initial KAP score was as low as 8.12 which increased to 20.40 after the nutrition education. The differences were found to be statistically significant at one per cent level of significance.

This finding revealed that proper nutrition education can improve the awareness about nutrition related problems and ways of overcoming them.

The feedback received from 125 participants towards lifestyle management programme of exercises was very much rewarding. Symptoms like pain in the joint and leg were drastically reduced among the selected women. This indicates that lifestyle management and exercise play a significant role in reduction of pain and other symptoms of osteoporosis.

Regarding entrepreneurial activity of the selected women, most of them started preparing the items at home scale level using nutri mixes and 60 per cent of them started home scale production and marketing of nutri mixes and cookies.