5. SUMMARY AND CONCLUSION

5.1 Introduction

Osteoporosis is a global public health problem currently affecting more than 200 million people worldwide. Women have higher chances of developing osteoporosis. This is due to the fact that women have lower peak bone mass and smaller bones than men. They also lose bone mineral density more rapidly than men in middle age because of the dramatic reduction in estrogen levels that occurs with menopause.

Population-based studies in India show prevalence of osteoporosis in male as 3% and female as 8% ICMR report [7]. In urban areas 48% of osteoporosis occurs in the lumbar spine and 17% in the femoral neck Paul (2008) [9]. When compared to the West, Indians have a lower average peak bone mass especially among women is observed. This is attributable to poor awareness of the role of food requirement with reference to calcium and vitamin D, particularly for the desirable bone mass density.

Thus, need was felt to create awareness among the women to prevent and manage the disease. Therefore the present research work titled “A study on the prevalence and management of osteoporosis in women with special reference to diet and yoga was carried out. The major objective of the study was to find out the impact of education, dietary supplement and yoga in the management of osteoporosis. The specific objectives of the study were to assess the prevalence of osteoporosis in adult women (41–60 years of age), to assess the risk factors associated with osteoporosis and to investigate the effect of intervention program with reference to education, dietary supplement and yoga on osteoporosis.

5.2 Review of related literature

The literatures reviewed pertaining to the present study has given an insight and support to the present findings. The literature reviewed were pertaining to Bone physiology, related risk factors to low bone mineral density as modifiable and the non-modifiable, prevalence rate in India and rest of the world and management of the disease.
5.3. Materials and methods

The selected area for the prevalence and the intervention study was the city of Bengaluru which is the capital of Karnataka. Bengaluru city is divided into eight zones by BBMP (Bruhat Bengaluru Mahanagara Palike). Out of 8 zones east zone is selected for the study. East zone of the city was selected for the prevalence study the areas covered under the study in screening the women for osteoporosis were; Beninganahalli, C. V. Raman Nagar, New Tippasandra, JeevanBhima Nagar, Halasuru, Shivaji Nagar and Domlur. C.V. Raman Nagar was selected for the intervention study to find out the impact of intervention on the management of osteoporosis with education, diet supplement and physical activity (yoga).

Selection of the subjects was done at two stages; First stage- prevalence study and Second stage- intervention study. The subjects selected for the prevalence study were women from age 41 years and 60 years who were employed and unemployed from the selected wards. However, women between 21 and 40 years when requested to undergo the screening test, they were considered on ethical grounds.

The screening for Bone Mineral Density (BMD) was carried out using Omnisense 7000S Quantitative Ultrasound (QUS), with the support of a doctor and a technician and the camps were considered as the platform for screening the subjects. Fifteen camps were conducted for a period of 24 months to obtain adequate number of subjects 1144 (One thousand one hundred and forty four only).

Post-menopausal women between 41 – 60 years, who were found to have osteopenia or osteoporosis based on prevalence study, were selected for the intervention study. A total of 92 subjects were selected and divided into four groups with equal representation. Only volunteers who expressed their willingness to participate in the intervention study were selected. Consent from these volunteers was obtained through Informed Consent Form (ICF). The ethical clearance was obtained from Institution Human Ethical Committee (IHEC), University of Mysore, Mysore.
The tools and techniques used for the study were questionnaire (general profile, reproductive history, medical history etc quality of life using Short Form (SF-36)), written quiz (awareness knowledge and physical performance), dietary survey, anthropometric measurements, Bone Mineral Density (BMD) test using (QUS) and Dual Energy X-ray Absorptiometry (DEXA) and Bio chemical parameters were used for the prevalence and intervention procedures. The materials used for the intervention were, education, dietary supplement and yoga as physical activity.

5.3.1. Different phases of the study

5.3.1.1. Phase I-Prevalence Study.

The subjects were screened for BMD using QUS omnisense 7000S Bone Densitometer. The general profile of the subjects was collected using a questionnaire. The anthropometric measures like height and weight were used to compute the BMI and Body Frame of the subjects.

5.3.1.1.1. Processing of Data : The data collected from the prevalence study was processed and the the subjects required for the intervention study were selected. The postmenopausal women who were osteopenic or osteoporotic and belong to 41-60 years of age were considered for the intervention study.

5.3.1.2 Phase II Preliminary Preparation of the Study.

The parameters selected for the intervention programme were education, diet supplement and yoga. Education was given on food, nutrition and in detail on osteoporosis in the form of lectures, demonstrations and seminars. The diet supplement was formulated using ragi, soya bean and skim milk powder with added calcium carbonate and vitamin D in the form of cholecalciferol. The yogasanas (yoga lessons) were selected with the help of instructors from SVYASA, Bengaluru.

5.3.1.3. Phase III Intervention Study.

One hundred and fifty four post menopausal women were selected (eligible) from the prevalence study who were either osteopenic or osteoporotic for the further test with DEXA to confirm osteoporosis. All the women (41-60 years) were from C.
V. Raman Nagar working in Defence Research and Development Organization (DRDO) or working in DRDO Kendriya Vidyalaya School or residing in DRDO Township. Out of 154 women only 112 women agreed for the DEXA (confirmatory) test after signing the informed Consent Form (ICF). Along with the DEXA test for BMD the supporting biochemical parameters like serum calcium, phosphorus, alkaline phosphatase and vitamin D$_3$ [25(OH)D$_3$] were analysed.

From the confirmatory test only 92 women were selected and grouped into four, each group comprising of 23 women. The groups were named as follows as ED, EDD, EDY, EDDY. The ED group received education, ED group received education and diet supplement, EDY group received education and yoga and EDDY group received education, diet supplement and yoga for a period of eight months. The education was conducted for one hour/week for all the groups. The EDD and the EDDY group received diet supplement in25g sachets and were advised to consume as porridge twice a day(25g once). The 50g of the sample provide 1000mg of calcium and 400 IU of vitamin D$_3$. The EDY and the EDDY group performed yoga for 45 minutes per day for three days in a week.

5.3.1.4. Phase IV Evaluation of the study

The major objective of the study was to find out the impact of intervention programme. To study the impact the following parameters were tested before and after intervention, the BMI, BMD (DEXA), biochemical parameters, knowledge, physical performance, 24hr dietary recall, Frequency of Food Consumption (FFC) and quality of life.

5.3.1.5. Phase V Processing of Data

The collected information was processed with Microsoft® Excel. Suitable statistical package (SPSS – version 15.0) was applied to formulate the tables and graphs of both the studies - prevalence and intervention. The statistical tests used to interpret the results were chi square, Kruskalwallis, post hoc using LSD, two tailed student t-test, Mc Nemar’s test and Relative Risk (RR). Based on the results, interpretations were drawn to report the findings.
5.4. Results and Discussions

The salient finding of the present is summarized and discussed here. A total of 1144 were screened using QUS. The women who participated in the prevalence study belong to 21+ year group. The results were summarized under three sections namely Prevalence of osteoporosis, Assessment of risk factors and Impact of intervention programme on management of osteoporosis.

5.4.1. Prevalence of osteoporosis

The characteristics of the study subjects were presented in percentage for general profile, reproductive history, medical history and life style of the subjects. The general and age based prevalence has been summarized and given.

5.4.1.1. General Profile of the Subjects

The majority (39%) of the subjects were in the age group of 41-50 years, followed by 31-40 years (27%) and 51-60 years (23%). Thirty percent of the women were graduates. An equal percentage of (20% and 19%) women were educated below SSLC and post graduate degree respectively. Higher percentages (72%) of the women were gainfully employed and only 28% were home makers. The large percentage (42%) of the women had family monthly income between Rs.12000 and Rs.30000 followed by 33% who had below Rs.12000 and 25% had income of Rs.30000 and above. Majority (87%) of the women was married and outnumbered the women who were either widowed/divorced (8%) or unmarried (5%). Seventy eight percent of the women had one to two children.

5.4.1.2. Reproductive History of the Subjects

Majority of women (53%) had attained menarche between 12 and 14 years followed by 24% of women in the age group of 14 to 16 years, and 21% of women attained menarche of age <12 years and 93% of the subjects had regular menstrual cycle.

The nature of menopause (Cessation of menstrual cycle) was natural or through hysterectomy. Sixty four percent of the subjects did not attain menopause.
Among the women who attained menopause, 24% of the women had natural menopause. Fifty one percent had menopause since 1-5 years, 25% of women between 6 and 10 years and 24% more than ten years.

5.4.1.3. Medical History

The disorders which cause secondary osteoporosis namely, hyperthyroidism, gastric ulcer, rheumatoid arthritis, bronchial asthma as stated by International Osteoporosis Foundation (IOF) tend to prevail among the respondents was 2%, 7%, 6% and 3% respectively.

5.4.1.4. Life Style

The percentage of vegetarians (51%) and non vegetarians (49%) were essentially similar. Information on consumption of nutrient supplements clearly revealed that 24% of the subjects were taking calcium supplements and 4% of the women were taking iron supplement. Among the calcium rich foods, many women consumed milk (36%) and curds (28%) daily compared with other foods like ragi, soya bean and green leafy vegetables. Majority (50%) of the women were going for regular walks. Yoga was practiced by 16% and aerobics and other exercise were performed by 1% and 2% respectively. In the present study 55% of the women claim to expose themselves to sunlight for 30 minutes per day.

5.4.1.5. Anthropometric Measurements

The height of the majority (87%) of the women ranged between 144.1cm – 163.1cm and 75% of the women were weighing between 50.6 and 75.2kgs. When BMI of women was observed, it was very surprising to notice that majority of the women were overweight and obese (65%) and only 3% were underweight and 28% of them were normal.

5.4.1.6. Prevalence of Osteoporosis with respect to BMD

Screening using Quantitative Ultra Sound (QUS) method on the bone mineral density based on the t score results indicated that 60% were normal and 40% had low bone mineral density. It is very evident from the study as age increased the
prevalence of osteoporosis also increased (21-40 years – 4%, 41 – 60 years - 10% and > 60 years – 63%).

5.4.2. Assessment of Risk Factors with the Occurrence of Low BMD-(Osteopenia / Osteoporosis)

Fifty four percentage of women had Low BMD leading to osteopenia and osteoporosis in the age group of 41-60 years. Thus the data were further analyzed to find out the risk factors associated with Low BMD – osteopenia/ osteoporosis. The results would be useful to plan further investigation to find out impact of intervention on the management of osteoporosis which is the major objective of the study as specified earlier. The risk factors which were assessed from the prevalence study are presented below.

5.4.2.1. Chronological age prevalence and LBMD – Osteopenia or Osteoporosis

It is noteworthy to find that Osteoporosis prevalence was found to be high (73%) among women aged between 51-60 years compared with women aged between 41-50 years (27%). The prevalence of osteoporosis is highly significant (p<0.01) as the age increases. The relative risk (RR) of developing osteoporosis was 1 to 2.4 times more as age increases years from 46-60 years compared to 41-45 years. The graph also depicts the same as age increases the osteoporosis also increases.

5.4.2.2. Educational Status and Prevalence of LBMD

It may be stated that education was highly significant (p<0.01) i.e. lower the educational level higher the incidence of osteoporosis. The Relative Risk (RR) of Low BMD in women for below SSLC was 2.3 times more and with SSLC 1.3 times more than that of the graduates. The RR for women with PUC/Diploma was only one time more than that of the graduates.

5.4.2.3. Menopause and Prevalence of Osteopenia or Osteoporosis

Sixty seven percentage of women who had not attained menopause, 27% who had attained menopause naturally and 6% who attained menopause surgically were found to have sufficient BMD. Forty four percentage of women who had not
attained menopause, 48% who had attained menopause naturally and 8% who attained menopause surgically were found to be osteopenic. Twenty three percentage of women who had not attained menopause, 42% who had attained menopause naturally and 32% who attained menopause surgically were found to be osteoporotic.

5.4.2.4. Duration of Menopause and prevalence of Low BMD

As the number of years since menopause increased the incidence of osteopenia and osteoporosis increased. This is evident from the table 4.12. The number of years since menopause had high significance (p<0.01) in the incidence of osteopenia and osteoporosis.

5.3.2.5. Life Style Factors I: Food Habits and Intake of Calcium Supplements and prevalence of BMD

Even though the significance was not seen in the incidence of osteoporosis among the vegetarians and non vegetarians (mixed diet) the RR-1; CI-0.8-1.6 was felt among the non vegetarians (mixed diet). The intake of calcium and vitamin D supplements did not have any significant effect on the bone health of the subjects. However the relative risk of developing osteoporosis was 0.9. [RR- 0.9; CI- 0.7 – 1.2].

5.4.2.6. Life Style Factors II: Exercise and Exposure to sunlight

Women who performed exercise at least 30 minutes per day as walking or aerobics or yoga the percentage of women decreased from normal, osteopenia to osteoporosis through 63%, 54% to 47%. On the other hand women who did not perform any exercise the percentage from normal, osteopenia to osteoporosis increased through 38%, 46% to 53% respectively.

Exposure to sunlight did not have any significant impact on the prevalence of osteoporosis however, a increasing trend was seen in the incidence of osteoporosis with RR 1; CI 0.9-1.1.

As age increases the incidence of osteoporosis also increases. The average age of normal women was 47 years, osteopenic women were 50 years and
osteoporosis was 53 years. High significant difference (p<0.01) was noted between the groups. On the contrarily it was highly significant (p<0.01) lower the income more the prevalence of osteoporosis. The duration of menopause had high significance with respect to osteoporosis. The average, duration (in years) was significantly high (p<0.01) in osteoporotic women than the normal and osteopenic women.

The height of the women had significance (p<0.05) between the normal and the osteopenic or osteoporotic group. Women who were standing and working significantly (p<0.05) for long hours (5±2) were osteoporotic than osteopenic and normal women.

5.4.2.7. Overview of the Risk factors

As age increases the incidence of osteoporosis also increases. The average age of normal women was 47 years, osteopenic women were 50 years and osteoporosis was 53 years. High significant difference (p<0.01) was noted between the groups. On the contrary it was highly significant (p<0.01) that lower the income more the prevalence of osteoporosis. The duration of menopause had high significance with respect to osteoporosis. The average, duration (in years) was significantly high (p<0.01) in osteoporotic women than the normal and osteopenic women. The height of the women had significance (p<0.05) between the normal and the osteopenic or osteoporotic group. Age of menarche, age of menopause, weight, BMI, wrist circumference, body frame, did not have any significant difference between normal, osteopenic and osteoporotic women.

5.4.3. Impact of Intervention on Management of Osteoporosis

The management of osteoporosis needs an integrated approach rather than one single approach because it was very clear that various factors were associated with osteoporosis and osteopenia. Hence, the intervention was carried out with three different approaches namely Education, Diet supplement and physical activity in the form of yoga. Four groups were formulated as stated in the methodology namely Group I - ED (Education), Group II – EDD(Education & Diet), Group III – EDY (Education & Yoga) and Group IV – EDDY (Education, Diet and Yoga).
The post-menopausal women (n=112) who were identified with osteoporosis, osteopenia from the first stage of the study (prevalence study) were considered for further confirmatory test with DEXA. Ninety two out of 112 subjects were selected for the study as they had osteoporosis / osteopenia. The selected subjects were grouped into four intervention groups based on the power analysis (specific statistical tool) with help of statistician.

Each of the group had equal representation of the subjects (n=23). Education was common to all the groups. ED group received only Education, EDD group received Education + 50gof diet supplement/day, EDY group received Education + Yoga (45minutes thrice a week) and EDDY group received Education, Diet supplement and Yoga as the EDD and EDY group. The intervention with education, diet supplement and yoga was carried out for eight months. The parameters that were measured before intervention were measured again to find out the impact of intervention.

The personal information elicited from the subjects before the start of the intervention was as follows: age, educational qualification, occupation, monthly income, reproductive history, medical history and life style factors like, food habits, intake of supplements, exercise and exposure to sunlight.

The anthropometric measurements reveal that all the subjects mean height, weight and BMI were essentially similar which ranged between 152-154cms, 65-68kgs, 27-29.5 respectively.

The intervention planned was for a period of eight months. Unfortunately till the end of intervention period only 12 subjects underwent the intervention in the ED group and 10 subjects from the other three groups (EDD, EDY and EDDY). More than 50% drop out was there in all the groups. The reason for drop out was the subjects were from heterogeneous group. Most of the women were working hence it was difficult for them to assemble in a common place to attend the yoga classes. Subjects who were consuming the diet supplement had difficulty in taking it twice a day without a break. Education was conducted in their office premises during their office hours towards the end of the day and due to their official work they could not
attend the classes regularly. With these limitations faced the impact of intervention studied with the subjects who sustained through intervention were presented below.

5.4.3.1. Impact of Intervention on Knowledge of Osteoporosis

The knowledge of the subjects on food, nutrition and osteoporosis was tested using a multiple choice written test on a score of 25. The knowledge of all the women in the respective groups was about 40-45% whereas in EDDY group where it was 56%. The knowledge increased significantly (p<0.01) about 20-25% in all the groups.

5.3.3.2. Impact of Intervention on Physical Performance

The physical performance of the EDY and EDDY group has significantly improved (p<0.01) in their physical performance whereas the ED and EDD group has not shown improvement in the performance. The improvement in the EDY and EDDY group performance might be contributed to the yoga which was one of the intervention parameter adopted by the group. The bone strength depends on the weight bearing exercise performed.

5.4.3.3. Food intake and Percentage of Adequacy

The consumption of cereals has decreased after intervention in all the groups. The percentage adequacy ranged from 60-70% in majority of the groups pre and post intervention. EDD and EDDY group percentage adequacy was 59% and 57%.

The intake of pulses was 43gm to 49gm before intervention in all the groups whereas after the intervention difference was noticed in the intake of pulse. In EDD and EDDY group pulse intake has shown a significant increase (p<0.05). This could be attributed to the diet supplement intake where soya bean has been added. A notable increase was observed in EDD group which was above (105%) the RDA requirement.

The pre intervention intake of GLV (Green Leafy Vegetables) was 31 to 38.7gm/day in all the groups. After the intervention GLV intake has improved significantly (p<0.05) in all the groups. Yet it did not meet the day’s requirement. It was below 50% in all the groups.
The intake of other vegetables was 120 to 160gm before intervention in all the groups. But after the intervention consumption of other vegetables rose to 154 to 187gm. EDD, EDY and EDDY group shown a significant increase (p<0.05) but EDD group has shown positive trend in the consumption of the other vegetables. Percentage adequacy increased from pre to post intervention and ranged between 77-93%.

The consumption of milk and milk products was 112 ml to 309ml. However after the intervention, it improved from 177 to 418ml in all the groups. The intervention has shown a positive trend towards intake of milk and milk products and has significantly increased (p<0.05) in all the groups.

5.4.3.4. Nutrient Intake and Adequacy

The energy intake of all the groups is below RDA. The protein intake in the EDD and EDDY group has increased significantly (p<0.05), ED group intake has been improved, whereas EDY group has not shown any improvement after the intervention. All the groups show increase in calcium intake. EDD, EDY and EDDY significantly (p<0.01) improved while ED group has not shown any significance but showed increase in the calcium intake.

The protein intake of all the groups improved in all the groups except for EDY group which was negligibly low. The calcium intake improved in all the groups. The EDD and the EDDY group which consumed the diet supplement had very good rise in calcium level, improved to more than 200% adequacy.

5.4.3.5. Impact of Intervention on BMI

The mean BMI of the subjects ranged from 27-31 (Overweight – Obese). The mean BMI between the groups were different but not within the group. There was no significant difference between the pre and post intervention. All the groups have retained the same mean BMI with ± 0.2-0.5 difference. This indicates that the subjects were maintaining their weight throughout eight months. The mean BMI of the EDDY group was high both before and after intervention.
5.4.3.6. BMD status at different sites

In the post intervention there was an insignificant improvement in the mean T-score of the ED and EDD group. The EDDY group showed a minor insignificant deterioration in the T-score. The EDY has shown decrease (p< 0.05) in the T-score. However, the decrease is only 2% which can be considered very negligible decrease. ED group showed significant improvement (p<0.05) in the Z score however no improvement was seen in EDD and the EDY groups. Results of YAM % derived from BMD compared with young revealed that significant decrease (p<0.05) was noticed in the EDY group. No improvement was observed in the ED and the EDD groups. The AM% showed improvement in ED and EDD groups exhibited but a significant impact was seen in the EDD group. The EDY and EDDY group did not show any impact on the AM%.

At femoral neck there was an improvement in the BMD, T-score, Z-score, YAM% and AM% among all the groups. However significant increase (p<0.05) was seen in the Z-score and AM% by 5% of EDY group.

The ward’s triangle indicates that there is an increase in BMD, T-score, Z-score, YAM% and AM% of ED and EDY group. However, significant increase (p<0.05) was noted in the Z-score and AM% of both the groups. The same trend was not noticed in the EDD and the EDDY group. Both the groups showed decrease in BMD, T-score, Z-score, YAM% and AM% but however no significant decrease was noticed.

The Fore arm results reveal that ED, EDD and EDY group’s BMD, T-score, Z-score, YAM% and AM% showed a positive trend in the values. The BMD measurement of ED and EDY group has shown a significant increase (p<0.05). The EDD group BMD values are same but the derived values T-score, Z-score, YAM% and AM% had a negative trend but however the decrease was not significant.

Overall observation of BMD at Lumbar spine indicated that there was a significant improvement only in ED and EDD group where education and diet supplementation were provided as intervention. This indicates that education and the diet supplement have made an impact on BMD. However, the combination of
education, diet supplement and yoga in the EDDY group did not show any impact on the BMD. There was no change in the BMD of EDDY group and surprisingly a significant decrease of BMD in EDY group was observed. Perhaps the reason for that decrease might be on performing yoga (physical activity) the spine takes time to show the improvement.

In general it may be stated that the impact of intervention in every group has shown improvement in the BMD status at femoral neck.

Over all the impact of education and yoga was better compared to the diet supplement and the combination of all the three in ward’s triangle.

The impact of education(ED), yoga (EDY) and the combination of education, diet supplement and yoga (EDDY) showed a positive impact on the BMD at Forearm.

The graph below reveals the AM% (Adult Matched %) at all sites. Overall the ED group had positive trend at all the sites and this could be attributed to the level of education. More than 60% of the subjects had education, graduation and above graduation. Hence it would be noted that the subjects were able to comprehend the lessons taken and implement in their day to day life and shown an improvement.

The next group which showed a positive trend is EDY group, followed by EDD group. It was surprising to note that EDDY group was suppose to show a positive trend but unfortunately it was not seen because the mean BMI of the group was relatively high compared to the other groups. Hence, the changes in the bone could yield a slow improvement.

5.4.3.7. Impact of Intervention with regard to Fracture Risk

The consequence of osteoporosis is fracture. The risk of fracture is studied with the help of the prediction of the radiologist from the BMD measurements from the reports furnished. McNemar’s test was used to find the risk of fracture in future.

In general the fracture risk prediction depicts a positive observation in EDY, ED, EDD and EDDY group.
5.4.3.8. Impact of Intervention on Biochemical Parameters

The Biochemical parameters support the BMD results. The table no. depicts the pre and the post intervention results of serum calcium, vitamin D₃ [25(OH) D₃], phosphorus and alkaline phosphatase. The serum calcium values increased in all the groups. Significant increase (p<0.05) was observed in ED group. The ED, EDD, EDY and EDDY group showed an increase in Serum 25(OH) D₃ values. However, significant increase was noticed in the EDD and EDDY group. The values of serum alkaline phosphatase and serum phosphorus have to decrease to show improvement. All the groups have shown improvement by indicating decreased values. Overall there was a positive trend in the biochemical values depicting that the impact of intervention as encouraging. The vitamin D₃ values significantly increased in EDD and EDDY group was because of the diet supplement where 400IU of vitamin D₃ was supplemented. The increase in the value of vitamin D₃ in EDD and EDDY group is a positive outcome of the present study which has a lot of scope in the formulations of diet supplement.

5.4.3.9. Quality of Life

ED, EDD and EDY groups showed a positive impact of intervention towards their quality of life. The Physical health and over all general health of EDY group has shown a significant increase (p<0.05) in quality. The impact of diet (EDD) and (EDY) yoga has showed a positive impact on their physical health, mental health and also improvement in overall general health, Whereas EDDY group did not show any positive impact on health.

5.4.4 Results on Testing the Hypothesis

- Education as such will not improve BMD status and manage osteoporosis - The hypothesis is rejected as the education has shown improvement in the BMD.
- Diet supplement as such will not improve BMD status and manage osteoporosis – The hypothesis is rejected as the diet has shown improvement in the BMD.
Yoga as such will not improve BMD status and manage osteoporosis – The hypothesis is rejected as the yoga has shown improvement in the BMD.

5.4.5 Limitations of the study

Few limitations observed in the present study are listed below.

1. The sample size for the prevalence study to find out the prevalence of osteoporosis could have been more than (n=1144) one zone to represent the Bangalore city, The Bengaluru city representation could have been done in all 5 zones of Bengaluru. This was not possible due to time and financial constraints.

2. The intervention study was planned for 23 subjects in each group but unfortunately the dropout rate was more than 50% because of the heterogenous group. The intervention study was planned for a period of eight months. Unfortunately till the end of intervention period only 12 subjects to 10 subjects were able to participate. Perhaps this drop out could have been prevented to an certain extent if an incentive was given to the subjects. This was not possible because of financial constraints and other administrative constraints.

3. The EDDY group which received all the parameters like education, diet supplement and yoga could not give positive results although other independent groups namely ED, EDD and EDY gave significant positive results. This result may be due to restricted number of subjects in the beginning of grouping of subjects for the intervention programme.

5.4.6. Recommendations

1. The main objective of the study was to manage osteoporosis. The findings of the study has given a positive insight to manage the low bone mineral density (Osteopenia/Osteoporosis) in women to improve the quality of life through education, on simple lifestyle (diet and exercise) modifications.

2. Low priced and easily available and yet reliable methods to test bone density should be developed for the Indians.
3. The findings of the study has given a positive insight to manage the los bone mineral density (Osteopenia/Osteoporosis) in women to improve the quality of life.

4. The medical fraternity, nutritionists and dietitians should join together to educate and create awareness in the society.

5. Osteoporosis should be considered as special health disorder of women and the ministry of health should develop suitable policy to combat this problem.

6. The scope of research is plenty in different areas of osteoporosis. Limited literature is available in our country hence this is a call for the researchers to explore in the field.

5.4.7. Conclusion

In general, the present study revealed that, the low bone mineral density prevailed was 26% osteopenia, leading to osteoporosis 14% were observed. The prevalence of low bone mineral density was among 54% of the women of 41-60 years. The findings also revealed that age, menopause, duration of menopause, exercise, standing and working for long hours were considered as risk factors as they were associated with low bone mass density. Apart from the factors mentioned the education and monthly income of the family also had impact on the BMD. Lower the education and income the higher the incidence of osteoporosis among the women.

The intervention programme had made a positive effect on the bone health. The education has improved the knowledge of all the subjects with respect to food, nutrition and osteoporosis and BMD in the Ed group. Diet supplement has improved the calcium and vitamin D3 levels in the blood and shown their effect on the bone. Overall consumption of pulse and milk and milk products have improved the protein and calcium intake. Yoga has improved the physical performance of the groups which were practicing yoga. The EDY which practiced the yoga by attending the yoga classes had positive outlook on physical and overall general health.

In general the study has given a positive insight in the use of materials for intervention. The materials used for intervention are indigenous materials easy to prepare and could be given to the target population. As the saying goes ‘teach to fish rather give fish’ imparting the knowledge through education with the help of audio
visual aids help the individual motivated. If you woman is educated the whole family is educated and at large the community get educated. Hence education could be considered a strong tool to carry forward the messages.

The diet supplement is another intervention tool to find out the impact of the programme. Instead of taking pharmaceutical drugs food supplemented with required nutrients (here calcium and vitamin D3) could help to overcome osteoporosis. The calcium is best observed when taken along with foods. Not only the diet supplement is important even the physical exercise is important for bone health. The physical exercise taken here was in the form of yoga. Yoga is a very ancient method of controlling mind, body and soul. In yoga both the bone and muscle mass are coordinated. Yoga practiced continuously helps to relax the muscles. The said interventions are easy to follow and cost effective.