Summary of

MINOR RESEARCH PROJECT

Calcium intake and Bone Mineral Density in

Perimenopausal and Postmenopausal Women

Submitted By

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Reproductive health is the ability of the women to pass thorough the reproductive years and beyond, with dignity and successful childbearing and to be free of gynecological disease and risk. Many researchers and policy advisors have emphasized that the real reproductive health framework should go beyond the narrow confines of family planning to encompass all aspects of human sexuality and reproductive health needs during the various stages of women's lives and their changing needs during the lifecycle.

Menopause typically occurs in a woman's late 40's to early 50's.It is usually different for every woman with fluctuating hormones which lead to various emotional and physiological symptoms. Menopause can be seen in three phases viz; the first phase, premenopause, where a little disruption of the ovarian function is observed and the menstrual cycle remains regular, nevertheless, a few symptoms may begin to occur. Perimenopause is a phase that represents declining ovarian function with menstrual irregularities and symptoms commonly start or become troublesome and this phase lasts till the end of the menses, lastly the postmenopausal stage where experiencing permanent cessation of menstrual cycle over a year is seen.

The average age of menopause falls at 50years; moreover worldwide estimates fall consistent within the range of 49 - 51 years. The median age at menopause ranges between 48 – 52 years. However considerable variation has been found in the timing of menopause.

During menopause women may experience vasomotor, urogenital and psychological symptoms as well as sexual dysfunction. These problems are often attributed to hormonal changes during mid life and are projected as health risk. The decline in estrogen after menopause can increase the risk for a number of health problems for women. It is at this time that there is an increased risk for osteoporosis and for cardiovascular diseases. Osteoporosis leads to considerable morbidity and mortality in postmenopausal women. In India, an estimated 12 million postmenopausal women suffer from osteoporosis and are at a lifetime risk of bone fracture.

Bone density increases through the growth period. The adolescent years are a window of opportunity to influence lifelong bone health. After 30 years, the bone loss occurs at rate of 0.7 per year. But after menopause due to estrogen deficiency, the bone loss is accelerated up to 2 percent per year for 10 years. (Postmenopausal osteoporosis Type I) and then the bone loss continues at much slower rate of 1 per cent per year as the ageing related loss. (Senile Osteoporosis Type II).

While osteoporosis can occur at any age and in either sex, it disproportionately strikes women over 50 years of age. The most significant period of bone loss occurs during the first five to seven years after menopause, during which time it is estimated up to 20% of bone may be lost. Osteoporosis has long been considered a disease of post menopausal women, which can be from the age of 45 years, but the greatest incidence is seen between the ages of 60 to 80 years. The consequences of osteoporosis are more evident in postmenopausal population; loss of bone density begins in perimenopausal years. The incidence of osteoporotic fractures is constantly increasing due to the increase in life expectancy. One in every third postmenopausal women is at risk of fracture. Those who sustain fracture of the spine not only loose height (resulting in defective posture), but also carry 15 to 20% excess mortality and only less than 1/3rd are able to return to their pre fracture status in one year's time.

Body size is strongly associated with bone mass and subjects with high body weight have higher bone density than subjects with lower weight. Advancing age and low BMI are important risk factors for the occurrence of low BMD. Low BMI is a well documented risk factor for future fracture. Thinness is reported to be related to both osteoporosis and increased fracture risk; hence, low BMI is included in the risk assessment tools for evaluation of osteoporosis and osteoporotic fracture risk. Increased BMI and higher activity levels have been stated to have a protective effect in women.

One of the most dramatic and profound change that occur with age is a loss in lean body mass (bone, muscle and organ mass). This loss is predominantly from skeletal muscles and can adversely affect mobility. Loss of bone (Osteopenia), if sufficient in magnitude, increases the risk of osteoporotic fractures. Menopause has been linked to reduction in lean mass and BMD both of which are directly related to a reduced output of ovarian hormones that is differentiated from the aging process. Several studies have shown a positive relationship between lean mass and BMD.

BMD is a strong predictor of fracture and can establish the diagnosis of osteoporosis before the first fracture has occurred. Low BMD is a risk factor for osteoporotic fractures. As a complex trait, BMD is determined by both environmental and genetic factors. The diagnosis of osteoporosis is made by measuring the BMD. The most popular method is DEXA. This technique is fast and most widely accepted method to measure BMD. The WHO defines patient's BMD as normal when the 'T- score is greater than -1.0, Osteopenia when between -1.0 and -2.5, osteoporotic when below -2.5 and severely osteoporotic when below -2.5 associated with one or more fragility fractures.BMD is the single most valuable predictor of osteoporotic fractures and accounts for about 89% of an individual's fracture risk.

One of the risk factors for bone loss, and thus the development of osteoporosis, is an inadequate dietary intake of nutrients important to bones. Bones undergo continuous remodeling and require an adequate supply of nutrient substrate to support the formation phase of bone remodeling. Dietary calcium, protein as well as phosphorus and vitamin D play an active role in bone metabolism. Other vitamins and minerals are also needed for metabolic processes related to bone, directly or indirectly. Calcium intake is necessary for bone mass synthesis and also for protection against osteoporosis which is an important public health problem in postmenopausal women. Calcium intake among women has drawn more attention in recent years since several studies showed a significant relationship between low calcium

intake and risk of osteoporosis as well as the relationship between increased calcium intake and maximizing peak bone mass during adolescent years. The average calcium intake has been observed to be at a low level among Indians who have an eating habit of low dairy products.

With increasing longevity of the Indian population, it is now being realized that, as in the West, osteoporotic fractures are a major cause of morbidity and mortality in the elderly. The prevention of osteoporosis in perimenopausal and postmenopausal women can be best achieved by identifying risk factors and providing appropriate intervention. This includes identification of women with low BMD. The present study has therefore been taken up to identify the risk factors in a cross section of adult and elderly women in the perimenopausal and postmenopausal stage.

The study has been conducted in two phases. In phase I the target population was 500 subjects comprising of 250 each in perimenopausal and postmenopausal status. Selection of subjects was by purposive sampling from private clinics (Gynecologist and Orthopedician) and yoga centre's located in West Nagpur. The inclusion criterion of the study subjects was age at or above 40 years for perimenopausal group and 40 to 70 in the postmenopausal group , willingness of the subjects to participate in the study and their consent for conducting BMD test. Women who had undergone surgical menopause, were on HRT, cancer sufferer and refused to participate in the study were excluded. The present study documents the status of perimenopausal and postmenopausal women in phase I with respect to demographical characteristics (age, religion, educational qualification, occupation, income status and type of family), reproductive history (age of menarche, age at menopause and parity), menopausal symptoms, musculoskeletal symptoms, BMI (Height and Weight), IBW (Broca's index). The nutritional adequacy of the diet was assessed through dietary recall and food frequency

schedule with special reference to calcium. Dietary and nutrient adequacy with special reference to macronutrients (carbohydrate, protein and fats), macro minerals (calcium, phosphorus and magnesium) was assessed and compared to recommended standards.

The target population in phase II included 50 women each from the base line study in the perimenopausal and the postmenopausal status. These women were selected on the basis of their consent to comply with assessment of bone mineral density (BMD). The same strategy used for base line study in phase I was employed for phase II along with BMD assessment. The BMD of all subjects under phase II was assessed by Dual Energy X ray Absorptiometry (DEXA). BMD at A.P. Spine (L1-L4), femoral neck (left and right), fore arm (left and right), was measured. (G.E. Lunar US, Pencil Beam Scan). The diagnosis of osteoporosis was done as per the WHO criteria.

The data is classified, tabulated and subjected to statistical analysis. Means, SD and minimum to maximum ranges and percentages are derived for all parameters under study. The data is analyzed using 't' test of significance for differences in age, dietary and nutrient adequacy with special reference to macronutrients (carbohydrate, protein and fats), macro minerals (calcium, phosphorus and magnesium), BMI, between the two group of subjects. Statistical correlations are derived between BMD at various sites (AP Spine, Femur Neck Left, Femur Neck Right, Left Forearm, and Right Forearm) to age, BMI status, nutrient intake with special reference to calcium intake in both perimenopausal and postmenopausal subjects in the phase II of the study. The significance of 'r' value is analyzed using 't' test .

The results have been statistically interpreted and discussed giving supporting studies wherever available.

Phase I

The distribution of subjects based on age shows that maximum number of subjects in the perimenopausal group is in the 40-49 years age group while subjects in the post menopausal

group are in the age of 50-59 years. Data from the study shows that 50% of the subjects are graduates. Post graduate subjects are also seen in both the groups indicating that the educational status in the study group is fairly good. However observation on occupation shows that more than 70% of the subjects are housewives. The income status of families is fairly good indicating that almost 50% are in the category with an annual income of 6 lacs. It is observed that more than 70% of the subjects in both the groups belong to nuclear families. The numbers of family members however vary between a minimum of 2-3 to a maximum of more than 8.

Data on physical activity level shows that the percentage of subjects exercising regularly is 33.6% and 38% in perimenopausal and postmenopausal group. Walking and yoga are found to be the most performed activities in the exercise schedule of both perimenopausal and postmenopausal subjects. In the postmenopausal subjects a higher percentage of subjects are resorting to walking as a physical exercise in their daily schedule. Observations reveal that almost 88% to 100% subjects in the perimenopausal and postmenopausal group have poor exposure to sunlight. The subjects of the study are mainly drawn from higher middle income group and are living in flat schemes, where in they did not have much access to sunlight. Observations show that a majority of the subjects in both the groups are leading a sedentary life style. .

Data on family history of diseases reveals high percentage of subjects with family history of diabetes and blood pressure in both perimenopausal and postmenopausal subjects. The data on reproductive history shows that the mean age at menarche in both the group of subjects is more or less similar 13.39 ± 1.01 in perimenopausal subjects and 13.41 ± 1.21in postmenopausal subjects.

The mean age at menopause is seen to be 49 years. A maximum percent of subjects (69.6%) are in the age group of 50-59 in the postmenopausal stage. About 25.2% of the postmenopausal subjects are above 60 years of age group.

The most frequent menopausal symptom experienced by both the group of subjects are hot flushes and sweating, irregularities in periods, skipping periods, pain in back and legs and mood swings. About 39.2 % in perimenopausal and 59.2% in postmenopausal group indicated irregularities in their period during the onset of menopause. Urinary tract infection and irritability is also reported by almost 20% of the subjects who are now in the postmenopausal stage. A very high percentage (46.8%) of subjects in the perimenopausal stage experience symptoms of irritability.

Joint pain and backache are experienced by a higher percentage (33.6% and 39.6% joint pain; 36.4% and 38.4% experienced back ache in perimenopausal and postmenopausal subjects respectively). A very high percentage (46.8%) of subjects in the perimenopausal stage experienced symptoms of irritability.

Data on body weight of the subjects show that the mean weight is found to be comparatively lower 59.9 ± 8.96 Kg in the perimenopausal subject as compared to postmenopausal subjects 62.18 ± 7.79Kg . Maximum percentages of subjects were housewives and sedentary workers. Reduced mobility due to problems of bone health may also be a contributory factor.

Assessment of nutritional status of the subjects using the BMI criteria show that more than 50% of subjects in the postmenopausal group fall in Obesity Grade I category as compared to 32.8% in the perimenopausal group. Overweight and obesity are associated with insulin

resistance and metabolic syndrome. Metabolic syndrome in menopausal women needs to be identified and treated. Obesity and reduced physical activity in postmenopausal women have been correlated to a decline in BMD.

Data on dietary intake reflects a higher percentage of vegetarian subjects in both the groups. A large percentage of subjects indicated following a two meal pattern which included only lunch and dinner. The reason of avoiding breakfast in this particular group of subjects is that, it is not a usual practice to eat in the morning.

The energy intake of study subjects is found to meet 94.36% (Perimenopausal) and 88.78% (Postmenopausal). The diets are therefore found to be fairly adequate in the energy intake.

The protein intake of subjects in postmenopausal group was found to be lower than RDA (44.41 g $\pm$ 6.33) meeting an adequacy of 77.9%. Subjects in perimenopausal group showed a slightly higher protein intake (48.24 gm $\pm$ 8.58) meeting an adequacy of 84.63%.

In contrast to the deficient intake of protein the study subjects show an almost double the intake of fat as compared to RDA. The percent adequacy as compared to RDA is very high.

The mean intake of carbohydrate is found to meet 60-65% of RDA in both groups of subjects.

The percentage of energy derived from the major nutrients differed from the recommended standards reflecting a decrease in carbohydrate and protein energy percent and an increase in fat energy percent, clearly pointing out to the probable reason of obesity grade I observed in postmenopausal subjects meeting only 50% of requirement.

The calcium intake of both the group of subject is found to be grossly deficient in meeting only 50% of requirement.

The mean phosphorous and magnesium intakes observed are within the recommended range of nutrients. However since calcium intake is grossly deficient the calcium phosphorous ratio is found to be affected.

The data shows that calcium rich sources lack in the diet of both perimenopausal and postmenopausal subjects.

Lack of awareness seems to be a factor for less use of most of the seeds which are rich sources of calcium and easily available.

The use of leafy vegetables is also infrequent, except for curry leaves which however is used for seasoning of dals and curries. Wood apple a good source of calcium is used infrequently by the subjects.

It is surprising to note that none of the subject is taking milk as a beverage regularly. Milk product like paneer is consumed occasionally whereas cheese is never consumed.

Phase II

Low BMD in premenopausal or perimenopausal women can arise from their failure to accrue adequate peak bone loss, from loss of BMD subsequent to peak bone mass attainment, or both. Low BMD is regarded as a risk factor for osteoporosis in post menopausal women leading to problems of mobility and fractures.

The data on BMD of perimenopausal and postmenopausal subjects is classified as per the criteria of WHO and interpreted. Statistical differences in the 'T 'scores obtained for BMD at each site between the two groups of subjects is assessed.

The 'T' score at AP spine in perimenopausal subjects are found to be lower as compared to postmenopausal subjects. This difference is found to be statistically significant.

As per the WHO criteria for osteoporosis the results show that the state of AP spine in perimenopausal women is normal while that observed in the postmenopausal subjects has gone in to the stage of Osteopenia. These observations therefore reflect postural changes taking place in postmenopausal women which also leads to back pain.

The 'T' scores for the femur neck left are also found to be higher and significant in postmenopausal subjects as compared to perimenopausal subjects. The mean value observed for T scores at femur neck right is found to differ significantly in perimenopausal and postmenopausal subjects respectively.

The observation on mean T score value for left fore arm also reflect higher scores in postmenopausal subjects as compared to the perimenopausal subjects. The difference is found to be significant. As compared to femur neck left and femur neck right T score value in postmenopausal subject, the left fore arm mean T score is found to be higher and almost indicative of osteopenia as per WHO criteria.

The mean T score value at right fore arm in perimenopausal women are observed to be comparatively higher (-1.06 ± 0.91) than the mean T score value observed at other sites. Nevertheless it is falling in the normal criteria as per the WHO standards. The mean T score values of postmenopausal women are significantly higher than the mean T score value of perimenopausal women and show osteopenia. Understanding the relationship between

physical activity, body composition and bone density in young women can be of benefit to osteoporosis prevention later in life.

The relationship of BMI between the two groups of subject has been compared with BMD measurements at different sites to study the relationship between the two variables. Body weight is stated to affect BMD thorough mechanical stresses placed on skeletal. However composition of the weight may be more important than the body weight alone. Studies on postmenopausal women document that bone free lean body mass exerted a greater impact on total body, lumber spine, and total hip BMD than fat mass.

BMD status is observed to be inversely proportional to the BMI. Lower the BMI, higher are the 'T' scores observed at all sites both in perimenopausal and postmenopausal subjects and vice versa.

Perimenopausal subjects in the normal category show osteopenia at all sites except the AP Spine while those in overweight category show osteopenia only at two sites (Left fore arm and right fore arm). The Obese Grade I subjects show osteoporosis at AP Spine and arm, and osteopenia at rest of the sites. In Obese Grade I and II category perimenopausal subjects do not show osteopenia at any of the site.

The postmenopausal subjects in overweight category show osteoporosis at AP Spine and left fore arm and osteopenia at rest of the sites. Subjects in Obesity Grade I and Grade II category show osteopenia at all sites. A single subject in the underweight category showed osteoporosis at different sites. However the underweight postmenopausal subjects reflect very high scores at all sites indicative of osteoporosis.The normal weight subjects show osteopenia at femur neck left and femur neck right.

Results thus show that there is a strong relationship of BMI status of subjects to BMD measurements.

The bone parameters have been analyzed in relation to BMI and bone health and its association to nutritional status is evaluated.

Subjects in the perimenopausal group with a mean age of 44.84 ± 3.48 show a mean BMI 26.2 ± 3.64, thereby falling into the overweight category. The BMD at femur neck left, femur neck right and left fore arm of these group of subjects show a significant relationship to the BMI status. AP spine score and right fore arm show a non significant relationship to BMI.

Subjects in the postmenopausal group with a mean age of 55.6 ± 5.01 are also found to be in the overweight category showing the mean BMI of 27.04 ± 4.17. A significant relationship is observed between the BMI status and the BMD at all sites in this group of subjects except for the AP spine.

The results of the present study are in agreement with those reported by earlier investigator on bone status of Indian women which report that BMD at all selected sites increase significantly with increasing body weight and BMI of women. Apart from the body weight; age, menopause and calcium intake are the other determinants of BMD. Factors related to BMD that lead to augmentation of lean body mass and maintenance of optimum weight in women and are required to prevent osteoporosis need to be identified.

The results on mean dietary calcium intake very strongly point out to the fact that, with increasing age and beyond menopausal stage, a significant reduction in calcium intake is evident. This may perhaps be attributed to either decrease in food intake due to associated problems of ageing or absence of calcium rich food supplements in the diet.

A significant decrease in the calcium intake (421.62mg $\pm$ 164.88) is observed in subjects in postmenopausal group as compared to the perimenopausal group (534.31mg + 183.69). The data on mean calcium intake further reflects that there is a decrease in mean intake with increase in age in both the groups of subjects.

Calcium as a nutrient is most commonly associated with formation and metabolism of bone. Calcium is one of the bones forming mineral and appropriate supply to bone is essential at all stages of life.

The relationship of calcium ingested to BMD has been studied in the present investigation. . An attempt is made to classify the subjects based on their calcium intake according to their RDA (800 mg/day). Observations reflect that a higher number of subjects in the postmenopausal group fall in the below 50% RDA category (<400mg/d). In contrast in the perimenopausal group more number of subjects are noted in the above 50% RDA intake (>400mg/d).

Significant correlation is observed between calcium intake and BMD at only the AP spine site in the perimenopausal group. In contrast the correlation is found to be significant at all sites in postmenopausal subjects. The results of BMD analysis have also indicated that the postmenopausal groups of subjects have gone into stage of osteopenia and osteoporosis. It is therefore interesting to know that, the BMD status shows a significant correlation to the calcium intake.

 The results of the present study also point out to a number of risk factors observed in the postmenopausal women that can lead to poor bone health and therefore affect quality of life. The subjects in the postmenopausal study group though do not show severe degree of osteoporosis as evident by the measurement of the BMD at different sites; nevertheless most of them are osteopenic and also show osteoporosis especially at AP Spine. This is a clear

indication of progressing bone disease and may show muscoskeletal symptoms especially joint and back pain.

The calcium intake is inadequate and less than 50% of recommended intake. The deficit calcium and protein intake coupled with poor exercise schedule and poor exposure to sunlight are factors that essentially aggravate bone disease in postmenopausal women. The perimenopausal women reflect a better status comparatively though deficient intake of protein and calcium is evident in their diets also. The diets however do not meet the recommended intake of protein and calcium while the fat intake is almost twice the recommended allowance.

Endogenous risk factors such as age, altered menstrual status, low bone mass, positive family history and exogenous factors such as nutrition (milk, calcium and Vitamin D) and low or absence of physical exercise, sedentary lifestyle and lack of awareness are seen to be the risk factors for osteoporosis in postmenopausal group of subjects.

Under current demographic trends, menopausal and postmenopausal health has emerged as an important public health concern in India owing to improved economic conditions, rapid lifestyle changes and increased longevity. All those involved in the planning and execution of health policies need to realize the gravity of the risk factors associated with menopause and lay down special funds for creating awareness among this group before they fall victims to the agonizing and aggravating symptoms effecting their health and quality of life.

Post menopause begins at a time that is not recognized until after 12 months of amenorrhea. With a life expectancy close to 80 years, the average woman is postmenopausal

for one third of her life. The incidence of certain conditions (e.g., coronary artery disease, diabetes, breast cancer, colon cancer) increases after menopause. Family physicians have an opportunity to address preventive health care measures with postmenopausal women and encourage healthy lifestyle choices. Health maintenance and preventive care recommendations for perimenopausal and postmenopausal women are summarized:

- Osteoporosis leads to lifetime risk of bone fracture. Early detection of bone loss by measurement of BMD helps to confirm the diagnosis of osteoporosis and assess the future risk of osteoporotic fracture in menopausal women. DEXA (Dual Energy X Ray Absorptiometry) is considered to be, "Gold Standard" in accuracy and reliability in the diagnosis of osteoporosis.

- Diagnosis in perimenopausal and postmenopausal women may help in identifying bone health status and prevent morbidity, bone fractures and immobility. However osteoporosis is more easily preventable than treatable.

- Prevention has to start early in all those at risk. Women reaching perimenopausal age needs to be encouraged to obtain a diet adequate in all nutrients and especially fulfill the calcium requirements.

- The period following post menopause is described as that of accelerated bone loss. Increased calcium intake is therefore recommended to suppress parathyroid and remodeling activity, improve balance and protect bone mass.

- Dietary requirements for calcium are determined by the needs for bone development and maintenance, which vary throughout the life stage with greater needs during periods of rapid growth in childhood and adolescence, during pregnancy and lactation, and in later life. In later years, inadequate dietary calcium accelerates bone loss and may contribute to osteoporosis.

- Inadequate dietary intake and age related changes in the absorption, utilization or excretion of nutrients may affect health status in menopausal women. Regular exercise and proper dietary intake are key elements in maintaining maximum bone mineral density.

- Lifestyle modifications, screenings, early identification, and appropriate intervention may prevent many chronic conditions that cause morbidity and mortality during postmenopausal years.

- **Osteoporosis Screening**

➢ One half of all postmenopausal women will have an osteoporotic fracture during their lifetime. Screening of younger postmenopausal women at increased risk of osteoporotic fractures is important. This tool takes into account bone mineral density score and other clinical risk factors for osteoporosis, including personal and family history of fracture, age, weight, race, sex, steroid use, smoking, and excessive alcohol intake. Treatment is recommended for women with osteoporosis, and those with low bone mass and a 10-year hip fracture probability of 3 percent or more, or a 10-year major fracture risk of 20 percent or more based on the WHO absolute fracture risk model.

- **Calcium and Vitamin D**

➢ Adequate intake of calcium and vitamin D should be encouraged for all postmenopausal women to reduce bone loss. Evidence suggests that adequate calcium and vitamin D intake reduces bone loss in perimenopausal and postmenopausal women. Calcium also potentiates the effects of exercise on bone mineral density in postmenopausal women.

➢ The National Institutes of Health (NIH) recommends 1,000 mg of calcium per day for postmenopausal women younger than 65 years who take estrogen, and 1,500 mg per

day for those who do not take estrogen. The NIH recommends that all women 65 years and older take 1,500 mg of calcium per day.

➤ Vitamin D plays a major role in calcium absorption and bone health. Vitamin D is formed in the skin following direct exposure to sunlight. Usually 10 to 15 minutes of exposure of hands, arms, and face two to three times per week satisfies the body's vitamin D requirement. Other sources include vitamin D–fortified foods, such as milk, yogurt, cheese, bread, orange juice, and oily fish (e.g., sardines, salmon, tuna). The current recommendation for daily vitamin D3 intake is 800 to 1,000 IU per day. Serum 25(OH) D levels should be measured in women at high risk of vitamin D deficiency (e.g., older women, women with malabsorption [celiac disease], women who are homebound or institutionalized, women with dark skin).

- **Lifestyle Modification**

➤ Coronary artery disease is the leading cause of death in women. Postmenopausal women should be counseled regarding lifestyle modification, including smoking cessation and regular physical activity. All women should receive periodic measurement of blood pressure and lipids. Appropriate pharmacotherapy should be initiated when indicated. Women should receive breast cancer screening every one to two years beginning at age 40, as well as colorectal cancer screening beginning at age 50. Women younger than 65 years who are sexually active and have a cervix should receive routine cervical cancer screening. Recommended immunizations for menopausal women include an annual influenza vaccine, a tetanus and diphtheria toxoid booster every 10 years, and a one-time pneumococcal vaccine after age 65 years**.**

- **Exercise**

➤ Regular weight-bearing exercise can reduce the risk of developing osteoporotic fractures in postmenopausal women. A recent randomized controlled trial (RCT) revealed that brisk walking combined with moderate resistance training improved muscle strength, balance, and walking performance in women who recently went through menopause. Dividing the walking into two daily sessions was found to be more feasible than continuous walking, and is easy to incorporate into everyday life.

Recommendations :

- Efforts are needed to increase public awareness of the importance of calcium intake from calcium rich foods and calcium supplements.

- Regular inclusion of milk and milk products, cereals and grains, green vegetables such as palak, and methi, soy products and tofu, and sea food such as salmon and oysters for calcium. Vitamin D is produced in our body from sun exposure and also found in egg yolks, liver and salt water fish.

- Engage in regular weight bearing and bone building exercise like running, jogging, walking, climbing stairs, dancing and aerobics. Exercise maintains muscle strength, coordination and balance which decreases risk of falls and related fractures.

- Avoid smoking and excessive alcohol intake.

- Take appropriate medications to improve bone density after consulting a physician.