PREVALENCE OF OSTEOPOROSIS AND EVALUATION OF ITS RISK FACTORS IN SURGICAL AND NATURAL POSTMENOPAUSAL WOMEN – A PILOT STUDY

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ABSTRACT:

Osteoporosis stands second next to cardiovascular disease as a global healthcare problem and it occurs more frequently with increasing age as bone tissue is progressively lost and in women, the loss of ovarian function at menopause precipitates rapid bone loss.

Aim: *This study was undertaken to estimate the prevalence of osteoporosis in postmenopausal women and to evaluate the effect of modifiable risk factors on bone mineral density (BMD).*

Materials & Methods: *8 surgical (SPMW) and 27 natural postmenopausal women (NPMW) who underwent systemic DEXA scan were chosen for this cross sectional study. Body height and weight were measured, and body mass index (BMI) was calculated. Other predictor variables of BMD were obtained using a questionnaire. Secondary data such as BMD and serum calcium were collected retrospectively.*

Results: *Mean BMI of NPMW was 26 ± 2.76 and SPMW was 24.61 ± 6.25 and the mean BMD was 753.36 ± 176.2 g/cm^2 and 973.2 ± 108.28 g/cm^2 respectively. The Z score was -1.13 for NPMW and -0.42 for SPMW which was statistically significant.($p < 0.05$) The prevalence of osteoporosis among NPMW and SPMW was 44.82% and 37.5%.*

Conclusion : *This cross sectional study in postmenopausal women not only reveals a higher prevalence of osteoporosis, but also provides new insight into risk factors of osteoporosis like low BMI and higher age. Moreover, this also highlights the higher prevalence in comparatively young SPMW as shown by their low bone mass which predicts their vulnerability to develop osteoporosis in future.*

Key words: *Bone mineral density, postmenopausal status, osteoporosis.*

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INTRODUCTION:

Worldwide, incidence of new osteoporotic fractures during the year 2000 was around 9 million, of which Europe and America accounted for 51%, while most of the remaining cases occurred in the Western Pacific region and Southeast Asia[1]. Osteoporosis stands second next to cardiovascular disease as a global healthcare problem and expert groups expect an estimated increase in the number of osteoporosis patients to 36 million by 2013[(2)]. It is also suggested that 1 in 3 women over 50 will experience osteoporotic fractures, as will 1 in 5 men [(3, 4, 5)].

Osteoporosis is a multifactorial disease leading to progressive decrease in bone mineral density, decreased bone strength and increased risk of skeletal fractures [6].There is a reduction in bone density less than 2.5 standard deviations below the mean for healthy adults of the same race and gender occurring more frequently with increasing age as bone tissue is progressively lost[(7)]. The remodelling of bone (its formation and resorption) is a continuous process. Any combination of changes in the rates of formation and resorption which results in bone resorption exceeding bone formation can cause a decrease in bone mass after the age of 40 – 50. Skeletal mass begins to decline, at a faster rate in women than in men, and at different rates in different parts of the skeleton. There is a trend towards acceleration of bone loss in the perimenopausal years in women. The facts that accelerated bone loss accompanies the menopause in some women and that premature osteoporosis occurs when bilateral oophorectomy is performed prior to the age of normal menopause suggest that estrogens play a major role in preventing bone loss[(7)].

Bone mineral density (BMD) is commonly used to diagnose osteoporosis and to predict individual fracture risk more so in postmenopausal women (PMW) [(8)]. It is a function of peak bone mass and is an indicator of the rate of subsequent bone loss[(9)]. BMD is lost in PMW due to the decline in ovarian function and low bone mineral density leads to osteoporotic fractures[(10)]. Risk factors for osteoporotic fractures in PMW can be non- modifiable such as genetic factors, age, sex, and race [(11-14)] or potentially modifiable such as adequate nutrition, body weight [(15, 16)] and level of physical activity[(17)]. As body weight impacts both bone turnover and bone density, it has been more consistently demonstrated to be an important risk factor for vertebral and hip fractures[(18)].

Although, studies on BMD and menopausal status have been conducted in various countries, limited data are available regarding BMD and its determinants in our population. Hence this study was undertaken to estimate the prevalence of osteoporosis in postmenopausal women of Chennai and to evaluate the effects of modifiable risk factors like body weight, physical activity and dietary pattern on BMD.

Materials & Methods

Post menopausal women (natural = 27, surgical = 8) who underwent systemic DEXA scan in a hospital were chosen from the Medical Records Department and were

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included in this cross sectional study and the following details were collected from them after obtaining informed consent.

Women who attained menopause at least one year ago[19] were included for the study. Confounding variables such as women with history of asthma, Cushing's syndrome, other bone disorders, more than 2 months of confinement to bed, chronic use of drugs such as steroid therapy and HRT were excluded from the study.

Body weight and height were measured and BMI was calculated. Information on other predictor variables of BMD like age, family history of osteoporosis, daily calcium intake etc., were collected using a questionnaire. Daily calcium intake was assessed using a food frequency questionnaire, the calcium content of Indian food categories was assigned and the average daily calcium intake was calculated in mg/day[20].Secondary data such as BMD and serum calcium, serum phosphorus were collected retrospectively.

BMD was assessed at the lumbar spine (L1-L4) and expressed in g/cm^2.The results were expressed as Z score which is the number of standard deviations below or above the mean BMD value for people of the same age and the T score was expressed as the number of standard deviations below or above the mean BMD value for young adults (20 -30 yr old). A diagnosis of osteoporosis is based on a T score of < -2.5 SD[21] and also on Osteoporosis Self-assessment Tool which was calculated based on age and weight[22] World Health Organization has proposed a diagnostic classification for bone mineral density based on the T-score, which recognizes 3 categories: normal (T-score –1 or higher), osteopenia (T-score between –1 and –2.5) and osteoporosis (T-score –2.5 or less).

Data was analyzed using SPSS software version 15. Continuous variables were expressed in terms of mean and standard deviation Furthermore, analytical test such as *t* test was done for comparison.

RESULTS:

Table I shows the study parameters of the natural and surgical postmenopausal women. Among the 35 study participants, 27 were natural postmenopausal women (NPMW), 8 were surgical postmenopausal women (SPMW) and none were on hormonal replacement therapy. The mean age of the NPMW was 63.3 ± 12.18 years while that of the SPMW was 50.14 ± 5.24 years. The mean duration of menopause in SPMW was 14.33 ± 10.7 years. The data on mean duration of menopause in NPMW was inadequate and it is one of the limitations of our study. The mean BMI of the NPMW was 26 ± 2.76 and the mean BMI of the SPMW was 24.61 ± 6.25.

The mean calcium level of NPMW was 8.9 ± 0.44 mg/dl and that of SPMW was 8.3 ± 0.24 mg/dl. The mean phosphorus level of NPMW was 3.94 ± 1.02 mg/dl and that of SPMW was 5.7 ± 0.92 mg/dl.

The BMD of NPMW was 753.36 ± 176.2 g/cm^2 and it was found to be 973.2 ± 108.28 g/cm^2 in SPMW.

Table.1 shows the values of all the study parameters among natural postmenopausal women and surgical postmenopausal women

	Study parameters	Mean ± SD
	Natural PMW	SPMW
Age	63.3 ± 12.18 years	50.14 ± 5.24 years
Height	150.2 ± 7.32 Cms	159.3 ± 13.88 Cms
Weight	55.9 ± 10.1 kg	61.2 ± 11.8 kg
Body Mass Index(BMI)	26 ± 2.76	24.61 ± 6.25
Bone Mineral Density(BMD)	753.36 ± 176.2 g/cm^2	973.2 ± 108.28 g/cm^2
Plasma Calcium	8.9 ± 0.44 mg/dl	8.3 ± 0.24 mg/dl
Plasma Phosphorous	3.94 ± 1.02 mg/dl	5.7 ± 0.92 mg/dl
T-Score	-2.4	-1.23
Z-Score	-1.13	-0.42

Z score -Number of standard deviations below or above the mean BMD value for people of the same age and the

T score-Number of standard deviations below or above the mean BMD value for young adults (20 -30 yr old)

(Fig.1- bar diagram showing the bone mineral density of NPMW and SPMW which was statistically significant, P < 0.05)The T score was found to be -2.4 among NPMW and it was -1.23 among SPMW. The Z score was -1.13 for NPMW and it was found to be -0.42 for SPMW which was statistically significant (p < 0.05). (Fig.2 & Fig.3 - bar diagrams showing the Z Score and T Score of NPMW and SPMW respectively).The prevalence of osteoporosis was estimated to be 44.82% & 37.5% using OST index and 44.82% and

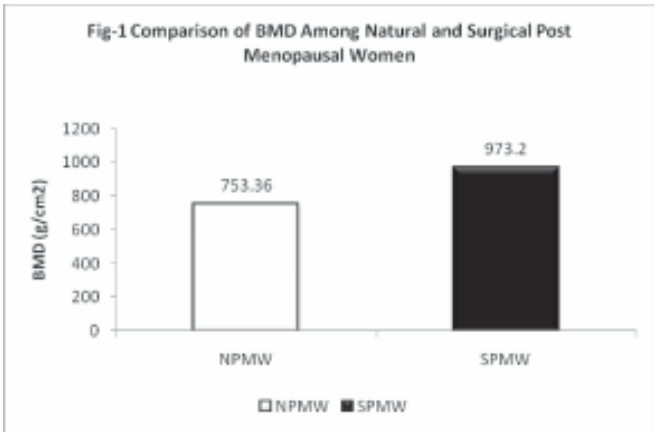

Fig.1 Comparison of bone mineral density among natural postmenopausal women and surgical postmenopausal women which was statistically significant (P < 0.05)

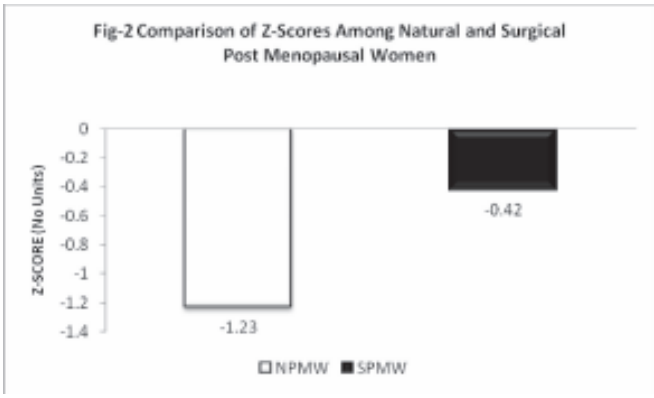

Fig.2 Comparison of Z Scores among natural postmenopausal women and surgical postmenopausal women

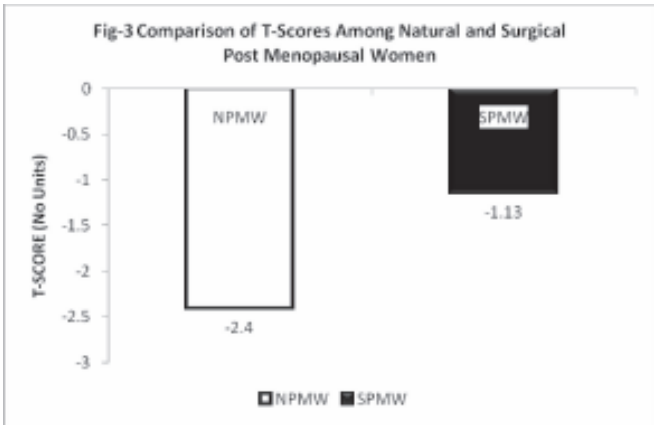

Fig.3 Comparison of T Scores among natural postmenopausal women and surgical postmenopausal women

12.5% using T score values among NPMW and SPMW respectively. A negative correlation was observed between age and the bone mineral density (bone mineral density decreases with increasing age) which was more significant in NPMW than in SPMW. There was no statistically significant association between the serum calcium, phosphorus levels and the menopausal status.

DISCUSSION:

Even though studies on BMD and menopausal status have been conducted in various countries [14, 23] limited data are available regarding BMD and its determinants in our population. Hence this study was undertaken to estimate the prevalence of osteoporosis in postmenopausal women of Chennai and to evaluate the effects of modifiable risk factors like body weight, physical activity and dietary pattern on BMD.

This pilot study was conducted among natural and surgical postmenopausal women to estimate the prevalence of osteoporosis using OST index and on the basis of T scores. It showed a higher prevalence of 44.82% in NPMW and 12.5% in SPMW. Advancing age and low body weight are associated with an increased risk for osteoporosis [24] and such a higher prevalence of osteoporosis encountered in this study could be due to interplay of various mechanisms that generally occur in postmenopausal women[24]. Hormonal factors strongly determine the rate of bone resorption; lack of estrogen (e.g. as a result of menopause) increases bone resorption as well as decrease the deposition of new bone that normally takes place in weight-bearing bones. The principal hormones secreted by the ovarian follicle are oestradiol, oestrone and androstenedione. The latter is also secreted by the adrenals at almost the same rate, and about 3% of it is converted to oestrone, contributing to greater fall in plasma oestradiol at the time of menopause than the fall in oestrone and androstenedione. Another explanation could be due to the lack of estrogen replacement for women at menopause, which virtually help maintain bone density and reduce the risk of development of osteoporosis and none of our study participants were on hormone replacement therapy. The possibility of little over reporting could not be denied due to the bias in the selection of study subjects as we considered only self reported cases.

In this study, lower BMD was observed in subjects with lower Body Mass Index (BMI).As BMI is a better marker of bone mineral density in the weight-bearing sites than in the non-weight-bearing sites, implying a mechanical effect of weight on bone mineral density, low body weight is known to be associated with an increased risk for osteoporosis and fractures[25, 26]. Moreover, total weight is the most consistent marker of overall BMD as all BMD except cortical BMD at the femoral neck show statistically significant associations with body weight[27]. In our study, irrespective of the type of menopausal status, simple correlation analysis indicated that BMD correlated significantly with BMI.

The T score of the NPMW in our study was -2.4 depicting the higher risk for osteoporosis in this category and it was only -1.23 for SPMW showing that these subjects do have a low bone mass and there are chances for them to develop osteoporosis in future provided they are not under HRT. This is consistent with lower T scores observed in an Australian study[28].

The more negative T score & Z score observed in the NPMW of our study could be also due to the additive effect of aging apart from the postmenopausal status. This is consistent with the studies reported by other authors who have observed significant negative correlations with age and total body BMD [29, 30]. Bone dissolves and is absorbed faster than the formation of new bone leading to thinner bones because of sudden decrease in estrogens as a result of menopause and also as a natural part of aging[31]. Moreover, there is greater reabsorption of Ca and phosphorous from the bones and a decrease in bone matrix. Physical inactivity that was reported in the postmenopausal women also may play an additional role.

In addition to estrogen, calcium metabolism plays a significant role in bone turnover, and deficiency of calcium and vitamin D may lead to impaired bone deposition. Moreover, the parathyroid glands react to low calcium levels by secreting parathyroid hormone which increases bone resorption to ensure sufficient

calcium in the blood.In any event, the rise in bone resorption produces a small rise in plasma calcium, phosphate and alkaline phosphatase and in urine calcium and hydroxyproline[32]. But in our study, the calcium level was well within normal limits and the phosphorus level was found to be raised in PMW although there was no significant difference in these levels between NPMW and SPMW. Moreover the extent of the rise in urine calcium and hyroxyproline and therefore presumably bone resorption is a function of the degree of 'oestrogen deficiency' in as much as the fasting urine calcium in post – menopausal women is an inverse function of the plasma oestrogen level[33,34,35]. Urinary calcium was not estimated, in our study, hence this was a limitation. It has been documented that post – menopausal women generally have less trabecular bone than age matched premenopausal women and oophorectomy is followed by a rapid fall in spinal density [36,37].

The limitations of our study are small sample size, failure to include premenopausal women for comparison, non availability of BMD of specific sites, non availability of data on post menopausal duration among NPMW and the selection of study group on the basis of physician referral for bone mineral densitometry instead of random sampling.

In conclusion, this cross sectional study conducted as a pilot effort in Chennai not only reveals a higher prevalence of osteoporosis, but also provides insight into risk factors of osteoporosis like low BMI and higher age among Indian postmenopausal women. Albeit the prevalence of osteoporosis is a known disease outcome in elderly NPMW, this study highlights the higher prevalence in comparatively young SPMW as shown by their low bone mass which predicts their vulnerability to develop osteoporosis in future. This also stresses the importance of dietary calcium intake and concludes that prevention of leanness is important for prevention of PM bone loss. The therapeutic triangle for osteoporosis in postmenopausal women is thus a combination of exercise to stimulate new bone formation, appropriate nutrition (calcium) to mineralise the newly formed osteoid and exogenous oestrogen to modulate the rate of bone loss. These in turn will maximize bone mineral accrual and result in optimal peak bone mass.

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