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Original Research Article

An epidemiological study to assess bone mineral density and its association with contributing factors among premenopausal and postmenopausal women in selected villages of District Shimla, Himachal Pradesh, India

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ABSTRACT

Background: Development of peak bone mass and premenopausal bone loss is determined by the menstrual status of women. Decline in bone mass with age becomes accelerated during menopause. Menopausal bone loss refers to the accelerated bone loss that occurs during the BM) of premenopausal and post-menopausal women, to identify the contributing factors associated with BMD among pre and post-menopausal women, to compare the level of BMD and the contributing factors of pre-menopausal women with post-menopausal women.
Methods: It was quantative research approach and epidemiological analytic research design was used. Total enumeration technique was adopted in this study.
Results: Analysis of data was done in accordance with the objectives of the study. Findings show that among premenopausal women 45.10% of the women had osteopenia and 8.20% of the women had osteoporosis, among postmenopausal women 50.00% of the women had oestriopenic and 41.2% of the women had osteoporosis. The analysis shows that factors such as BMI, Health status, life style, age, economic status and dietary patter plays important role to accelerate the level of T-score more than -1 in both group either premenopausal women or post-menopausal women. It shows the significance at the level of $p<0.001$.
Conclusions: The study was completed in July 2016, concludes that there are many factors that can lead to have risk of osteoporosis related fracture. As age is increased the risk is also increased to get the fracture. Every woman can go for screening of BMD test to control the risk of fracture.

Keywords: BMD, BMI, Osteopenia, Osteoporosis, Premenopausal women, Postmenopausal women

INTRODUCTION

Osteoporosis is a condition in which bone is more porous than average and is prone to fracture. During childhood and adolescence, bone is built up by cells called osteoblasts and broken down by cells called osteoclasts. Both groups of cells work in union to promote an increase in bone density and size as a result, bones are at their strongest during the late twenties and early thirties.[1] This effect balances out to allow the same amount of bone to be replaced as is broken down by late thirties. Following this, Bone density begins to be gradually lost due to the osteoclasts cells breaking down more bone than is replaced leading to osteoporosis.[2]

Osteoporosis or porous bone (fragile bone disease) is a chronic progressive metabolic bone disease characterized by low bone tissue leading to increase bone fragility.

Serum calcium, phosphorus and alkaline phosphate levels usually are normal, although alkaline phosphate may be elevated after the fracture.[3] At least 10 million people in the United States (80% women in that) suffers osteoporosis. One in two women over age 50 will sustain an osteoporosis related fracture during their life time. Women over 65 years old should be routinely screened for osteoporosis. Osteoporosis often goes unnoticed because it cannot be detected by conventional X-ray until more than 25% to 40% of calcium in the bone is lost.[4]

Osteoporosis is known silent thief because it slowly and insidiously over many years robs the skeleton of its banked resources. Bone can eventually become fragile and normal cause mechanical stress.[5]

Osteoporosis is more common in women than in men for several reasons: women tend to have lower calcium intake than men throughout their lives, women has less bone mass because of their generally smaller frame, bone re-absorption begins at an earlier age in women and is accelerated at menopause, pregnancy and breastfeeding deplete woman's skeletal reserve unless calcium intake is adequate; longevity increases the likelihood of osteoporosis.[6,7]

The seriousness of the problem can be judged by the facts that Osteoporotic fractures are four times more common than strokes.[8] 50 years old women have equal chance of dying from of complication of osteoporosis as from breast cancer. The process of demineralization leading to osteoporosis speeds up in women in the 10 years after the menopause. This is because the ovaries stop producing the female sex hormone- oestrogen, which is one of the substances that helps to keep bones strong.[9]

Development of peak bone mass and premenopausal bone loss is determined by the menstrual status of women. Decline in bone mass with age becomes accelerated during menopause. Menopausal bone loss refers to the accelerated bone loss that occurs during the premenopausal age and after the final menses.[10] Bone as a dynamic tissue constantly undergoes formation and re-absorption and the process is balanced in healthy adults, however the exceptions are growing children and menopause.[11]

Factors affecting the low bone density

Sampson HW (2002) conducted a study on alcohol and other factors affecting osteoporosis risk in women. He stated that not only the one factor affecting the low bone density, but there is an evidence of many other factors.[12]

The age, diet, life style, socioeconomic status, genetic factor, history of menopause, medical and surgical history is some of the contributing factor and also the BMI is the one factor, and these factor is for world-wide.[13,14]

Painless test

The Bone Mineral Density is the suitable test for the diagnosis. It is pain less procedure.[15] The Bone Mineral Density test can be done by three ways Dual Energy X-Ray Absorpitometery (DEXA), Quantative ultrasound (QUS), Fracture Risk Assessment Tool (FRAX). FRAX is the standardized tool by World Health Organization (WHO).[16]

Smellzer SC, et al mentioned that the test measures bone density in the spine, wrist, and/or hip (the most common sites of fractures due to osteoporosis), while others measure bone in the heel or hand. These tests are painless, non-invasive, and safe.[17] Bone density tests can

- Detect low bone density before a fracture occurs.
- Confirm a diagnosis of osteoporosis if you have already fractured.
- Predict your chances of fracturing in the future.
- Determine your rate of bone loss and/or monitor the effects of treatment if the test is conducted at intervals of a year or more.[18]

The Bone mineral density (BMD) include Quantitative Ultrasound (QUS) Dual Energy X-Ray Absorpitometery (DEXA). QUS measure the bone density with sound waves in the heel, kneecap etc. One of the most common BMD studies is DEXA which measure the Bone Density in the spine, hip, leg and forearm (the most common site of fracture resulting from osteoporosis). DEXA studies are also useful to evaluate changes in bone density over time and to assess the effectiveness of treatment.[19] Determining a patient's risk of fracture due to osteoporosis can also be calculated by Fracture Risk Assessment Tool (FRAX). The FRAX takes into account bone mineral density and additional clinical factor when assessing fracture risk. Prevention and treatment of osteoporosis focuses on adequate calcium intake (1000 mg/day) in premenopausal women who are not receiving supplementation calcium may be recommended.[20]

METHODS

In this study quantitative research approach was applied to assess the BMD and contributing factor associated with BMD. Epidemiological analytic research design was used in this study.

Study variables

Independent variable

In this study independent variable is contributing factors that can associate with the BMD.

Dependent variable

In this study dependant variable is Bone Mineral Density that can be varying because of its contributing factors.

The study was conducted in the villages of District Shimla [Halog (Dhami)]. In these 18 villages women were assessed for Bone Mineral Density. A two- days-camp was organized at Panchyat Bhawan of Dhami. The target population of the study comprises of Premenopausal and Postmenopausal women who attended the camp that was organized at Panchyat Bhawan Dhami. The sample of the study was Premenopausal women (30 years to till cessation of menstrual cycle) and Postmenopausal women (cessation of menstrual to70 years) who attended the camp at Panchyat Bhawan Dhami.

Inclusion criteria

The sample consists of pre-and postmenopausal women who are

- between 30 years of age to till cessation of menstrual cycle in premenopausal women and between the age of cessation of menstrual to 70 years in postmenopausal women.
- Residing in selected villages of Districts Shimla
- Able to communicate in English, Hindi or Dogari Language.
- Persons available at the time of data collection.
- Willing to participate in study.

Exclusion criteria

- The study excludes the women whose age below 30 years.
- Women in pregnancy, lactating or in post-partum less than 10 months.

Sampling technique

The sampling technique used as Total Enumeration Technique (consecutive sample technique, complete enumeration).

Sample size

A camp was organized in community. A Total Enumeration Technique was adopted, that is, each woman who visits the camp will be considered as the part of study. The total gathering of women in the camp was 332.

Development and description of tool

The tool was constructed after extensive review of literature and discussion with the experts and with the investigator's personal and professional experience.

Description of the tool

The tool consists of four sections.

- Section A: Consist of Performa for assessing profile of the women. It includes age in year, monthly income (in rupees), education, area of residence, occupation.
- Section B: It consists of a measuring tool. Under that two measuring tools (Anthropometric Measurement and Dual Energy X-ray Absorpitometery measuring tool for Bone Mineral Density) were used.
- Section C: It consists of the reproductive guide to obtain the profile of the women.
- Section D: It consists of structured questionnaire checklist that is (Modified Fracture Risk Assessment Tool). It is further divided into three parts. Part A is for Health Status, Part B is for Life Style and Part C is for Dietary Pattern

Scoring key

- For section A (Performa for assessing profile of the women) the scoring is done according to the category.
- For section B (measuring tool), part 1 Anthropometric measurement, scoring is done to assess the BMI level of women.

Table 1: BMI Scoring.

Category	BMI<25	BMI>25
Scoring	1	2

- For section B, part 2 Bone Mineral Density, standardized scoring was adopted to assess the BMD level of women.

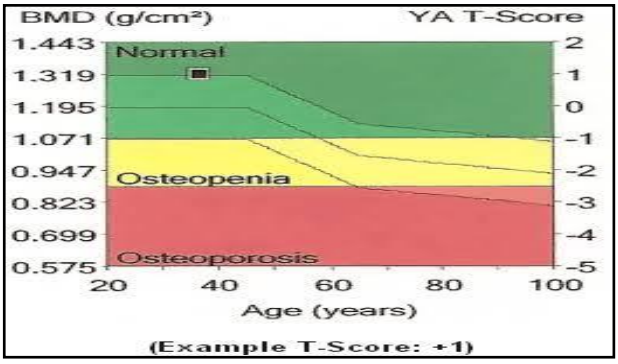

Figure 1: Scoring of BMD in (g/cm2) and T-scoring.

- For Section C and D scoring done according to the yes or no response of women. Scoring done as per the positive and negative expect of question.

Table 2: Responses of sample.

Question	Positive response	Negative response
Scoring	1	0

Reliability of the tool

The reliability of Modified Fracture Risk Assessment (MFRAT) tool was done by using split half method and Spearman's rank correlation coefficient was used to check the reliability of the tool. The tool was reliable at the level of r=0.81.

Pilot study

Pilot study is the trial rehearsal for the main study. The refined tool was used for the pilot study to test feasibility and reliability. After obtaining formal permission from the authorities the pilot study was conducted on 4thand 5th Feb 2016 among 10 non-study subjects selected at a non-study area by using Total Enumeration Technique. The study was conducted at urban area of the Tutu. The investigator gave self-introduction; explain the purpose of the study and a written consent was obtained from the subjects. The data was collected from the samples by using structured interview. For the findings of the pilot study; spearman's Rank correlation coefficient formula was used by adopted split half technique. The reliability of the pilot study is r = 0.81.

Procedure for data collection

A formal permission was obtained from the Principal-Akal College of Nursing, Sub Tahsildar Senior Medical Officer, Panchayat president and from the radiologist. The written consent was also taken from the study subjects of selected 18 villages who all come under the CHC Dhami, District Shimla, Himachal Pradesh. A camp was organized on 27th and 28th February 2016. Then the investigator explained the purpose of the study to the study participants and data was taken in various sections. Section one for free registration of checkup, section two for assessing the height and weight and section three was for assessing the Bone Mineral Density (BMD). The BMD was assessed from right Tibia bone of the women. Section four was for medical checkup by the experts (Doctors from Obstetrics and Gynecological and from Orthopedic department), section five was for gathering the data by interviewing through the Modified Fracture Risk Assessment Tool (MFRAT) to obtain the data for contributing factor. Section six was for distributing the free medicines as per the diagnosis of the patient and as per the prescription of the Doctors.

RESULTS

Figure 2 depicts the level of Bone Mineral Density of Pre-menopausal women in which 86 (46.70%) women were found normal, 83 (45.10%) were the sufferer from osteopenia and 15 (8.20%) of the women had osteoporosis. Among Post-menopausal women 13 (8.80%) were founded normal, 74 (50.00%) suffered from osteopenia and 61 (41.20%) of the women had osteoporosis.

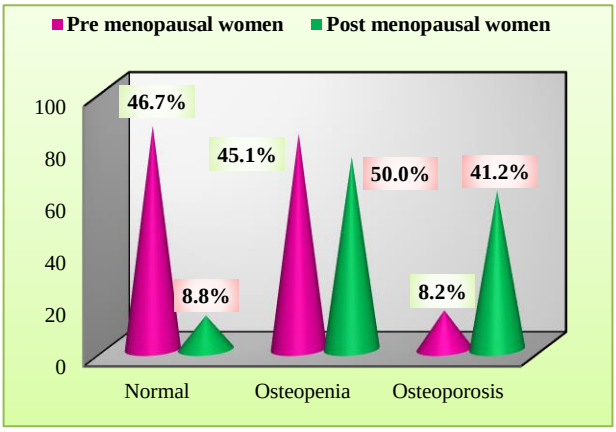

Figure 2: Percentage of BMD for premenopausal women postmenopausal women.

Table 3 depicts the relationship between Bone Mineral Density and its contributing factors by using Analysis of Variance of premenopausal women. The table indicates the significance at the level of p<0.001. In this study Body Mass Index, Health Status and the Dietary Pattern shows their level of significance p<0.001.

Table 3: Analysis of variance of BMD and its contributing factor of premenopausal women (N=184).

Factors		Sum of Squares	df	Mean square	F	Sig.
Body mass index	Between Groups	3.405	2	1.703	10.828	p<0.001**
	Within Groups	28.459	181	0.157		
Health status	Between Groups	4.067	2	2.034	7.583	p<0.001**
	Within Groups	48.542	181	0.268		
Life status	Between Groups	0.29	2	0.145	0.772	0.463^{NS}
	Within Groups	34.036	181	0.188		
Dietary pattern	Between Groups	5.709	2	2.854	13.379	p<0.001**
	Within Groups	38.617	181	0.213		

**significance at p<0.001 Level, Total no. of sample among premenopausal women was 184.

A one-way Analysis of Variance was conducted to evaluate the hypothesis that there is significance between the BMD and its associated factor that is (BMI, Health status, Life Style, Dietary pattern) among (N=184) premenopausal women. The variable, BMI shows the significance at the level of p<0.001**.

Table 4: Analysis of variance of BMD and its demographic factor of premenopausal women (N=184).

Demographical factors	Group	Sum of squares	Df	Mean square	F	Sig.
Age	Between groups	4.815	2	2.408	10.586	p<0.001**
	Within groups	41.163	181	0.227		
Economic status	Between groups	6.864	2	3.432	3.008	0.005*
	Within groups	206.506	181	1.141		
Education	Between groups	2.666	2	1.333	0.942	0.392^{NS}
	Within groups	256.29	181	1.416		
Area	Between groups	0.079	2	0.04	0.423	0.656^{NS}
	Within groups	16.959	181	0.094		
Occupation	Between groups	0.33	2	0.165	1.159	0.316^{NS}
	Within groups	25.795	181	0.143		

**significance at p<0.001 Level,*significance at p<0.05 Level and NS refers to Non significance.

Table 4 depicts the relationship between Bone Mineral Density and its demographical factors by using Analysis of Variance of premenopausal women. The table indicates the significance at the level of p<0.001 among Age of premenopausal women and significance level 0.005* in case of economic status of premenopausal women.

Table 5: Analysis of variance of BMD and its contributing factor of postmenopausal women (N=148).

Factor	groups	Sum of squares	Df	Mean square	F	Sig.
BMI	Between groups	1.997	2	0.998	4.176	p<0.001**
	Within groups	34.672	145	0.239		
Health status	Between groups	0.534	2	0.267	1.006	0.36^{NS}
	Within groups	38.46	145	0.265		
Life status	Between groups	2.16	2	1.08	4.34	p<0.001**
	Within groups	36.083	145	0.249		
Dietary pattern	Between groups	6.568	2	3.284	8.578	P<0.001**
	Within groups	55.513	145	0.383		

**significance at p<0.001 Level and NS refers to Non-Significance.

Table 6: Analysis of variance of BMD and its demographic factor of premenopausal women (N=148).

Demographic factor	Groups	Sum of squares	Df	Mean square	f	Sig.
Age	Between groups	2.091	2	1.045	1.856	0.001**
	Within groups	81.666	145	0.563		
Economic status	Between groups	8.348	2	4.174	3.636	0.002*
	Within groups	166.463	145	1.148		
education	Between groups	6.601	2	3.301	3.921	0.002*
	Within groups	122.068	145	0.842		
area of residence	Between groups	0.352	2	0.176	2.218	0.11^{NS}
	Within groups	11.506	145	0.079		
occupation	Between groups	0.184	2	0.092	0.983	0.37^{NS}
	Within groups	13.573	145	0.094		

**significance at p<0.001 Level, *significance at p<0.005 Level and NS refers to Non-Significance

Table 5 depicts the relationship between Bone Mineral Density and its contributing factors by using Analysis of Variance of postmenopausal women. The table indicates the significance at the level of p<0.001. In this study Body Mass Index, Health Status and the Dietary Pattern shows their level of significance p<0.001. A one-way Analysis of Variance was conducted to evaluate the hypothesis that there is significance between the BMD and its associated factor that is (BMI, Health status, Life Style, Dietary pattern) among (N=148) postmenopausal women. The variable, BMI shows the significance at the level of p<0.001**.

Table 6 depicts the relationship between Bone Mineral Density and its demographical factors by using Analysis of Variance of postmenopausal women. The table indicates the significance at the level of 0.001* among age of premenopausal women and significance level 0.002* in case of economic status and education of postmenopausal women.

Table 7: Applying independent 't' test to find out the difference of BMD and its contributing factors between premenopausal and postmenopausal women (N=332).

Total	Group	Mean±SD	F	Df	T	Sig.
BMD	Premenopausal	1.61±0.634	0.311	330	-10.169	0.578^{NS}
	Postmenopausal	2.32±0.630				
Health status category	Premenopausal	1.59±0.536	48.012	330	-6.984	p<0.001**
	Postmenopausal	1.99±0.515				
Life style category	Premenopausal	2.14±0.433	16.824	330	-2.230	p<0.001**
	Postmenopausal	2.26±0.510				
Dietary pattern	Premenopausal	2.14±0.492	33.392	330	-2.272	p<0.001**
	Postmenopausal	2.28±0.650				
BMI	Premenopausal	1.22±0.417	59.522	330	-4.568	p<0.001**
	Postmenopausal	1.45±0.499				

**significance at p<0.001 Level and NS refers to Non-significance.

Table 7 depicts the comparison of BMD and its associated contributing factors among premenopausal and postmenopausal women. The table shows there is highly significance at the level of p<0.001* among premenopausal and postmenopausal women in Health Status, Life Style, BMI and Dietary Pattern. Table shows no significance of BMD between premenopausal and postmenopausal women.

DISCUSSION

The first objective of this study was to assess the Bone Mineral Density (BMD) of premenopausal and post-menopausal women. The present findings of the study reveals that the level of Bone Mineral Density of Pre-menopausal women in which (46.70%) of women were found normal, (45.10%) were the sufferers from osteopenia and (8.20%) of the women had osteoporosis. Among Post-menopausal women (8.80%) were found normal, (50.00%) of the women suffered from osteopenia and (41.20%) of the women had osteoporosis.

To support this study, a study was conducted by Kadilkar to assess the prevalence and the relative importance of risk factors for low bone mass in Indian premenopausal and post-menopausal women. Data were collected on anthropometry and life style factors in apparently healthy 80 pre and 92 post- menopausal women of 40-75 years. BMD measurement was obtained using Dual Energy X ray Absorptiometry (DEXA). The results depicted that BMD at all three sites was significantly lower in postmenopausal than the pre-menopausal women (p <0.001). Prevalence of osteoporosis was the highest at the lumbar spine (25.8%) in post-menopausal women, while prevalence of osteopenia was high in pre-menopausal women (44.3%).[21]

The second objective of this study was to identify the contributing factors associated with Bone Mineral Density (BMD) of this study among premenopausal women. In present study identifying the hypothesis that there is significance between the BMD and its associated factor that is (BMI, Health status, Life Style, Dietary pattern and also the demographic variables) among (N=184) premenopausal women. The variable, BMI, Health status, Dietary pattern and age show the significance at the level of p<0.001*. And the economic status shows 0.005* significance level.

To support these study findings for second objectives, a study was conducted by Kadam et al to assess the prevalence and the relative importance of risk factors for low bone mass in Indian pre- and post-menopausal women. Data were collected on anthropometry and life style factors in apparently healthy 80 pre and 92 post-menopausal women of 40 – 75 years. BMD measurement was obtained using Dual Energy X ray Absorptiometry (DEXA). The results depicted that BMD at all three sites

was significantly lower in postmenopausal than the pre-menopausal women ($p<0.001$). Prevalence of osteoporosis was the highest at the lumbar spine (25.8%) in post-menopausal women, while prevalence of osteopenia was high in pre-menopausal women (44.3%). The major risk factors contributing to bone loss in Indian women above 40 years of age observed were age, weight, height, menopause, low intakes of calcium and low 25(OH)D along with poor sunlight exposure.[22]

The third objective of this study was to identify the contributing factors associated with Bone Mineral Density (BMD) of the study among post- menopausal women. In the present study evaluating the hypothesis that there is significance between the BMD and its associated factor that is (BMI, health status, life style, dietary pattern and also the demographic variables) among (N=148) postmenopausal women. The variable, BMI, life style, dietary pattern and age show the significance at the level of $p<0.001$*, and the economic status and education shows 0.002* significance level.

To support this study, a study conducted by Paul T et al assessed the prevalence of osteoporosis among ambulatory postmenopausal women in a semi urban region of southern India and studied the dietary calcium intake and vitamin D status and their influence on bone mineral density. This community-based cross-sectional study adopting a randomized cluster sampling technique included a cohort consisted of 150 ambulatory postmenopausal women (50 years old). Dual-energy x-ray absorptiometry for BMD was performed at the lumbar spine and femoral neck. Dietary calcium intake and biochemical variables were assessed. The prevalence of osteoporosis was found to be 48% at the lumbar spine, 16.7% at the femoral neck, and 50% at any site. The mean dietary calcium intake was much lower than the recommended intake for this age-group. There was a significant positive correlation between body mass index and BMD at the lumbar spine and the femoral neck ($r = 0.4$; $p=0.0001$). BMD at the femoral neck was significantly less (mean, 0.657 versus 0.694 g/cm^2) in the vitamin D-insufficient study subjects in comparison with the vitamin D-sufficient women ($p=0.03$). This study emphasizes the need to take measures such as adequate calcium intake and vitamin D supplementation in women of this age-group to prevent osteoporosis and its complications.[23]

The fourth objective of the study was to compare the level of Bone Mineral Density (BMD) and the contributing factors of premenopausal women with postmenopausal women. The findings show there is highly significance at the level of $p<0.001$* among premenopausal and postmenopausal women in health status, life status, bmi and dietary pattern. The table shows no significance of BMD between premenopausal and postmenopausal women.

To support these study findings for objectives, a study was conducted Gandhi BA et al found out the incidences of osteopenia and osteoporosis and their relationship with age, diet and menstruation in women above the age of 40 years. The sample included 200 women attending a well women clinic during January 2002 to December 2003. They all underwent BMD test, mammography, pelvic sonography, X-ray chest, ECG and other basic investigations. The analyzed results revealed that there was an almost 100% incidence of either osteopenia or osteoporosis among women above the age of 60 years whereas, the incidence of osteopenia was 34% and osteoporosis 8% in the age group of 40 and 60 years. The finding related to type of diet depicted that 50% of osteoporotic and 98.82% of osteopenic women had vegetarian diet. The study findings revealed that a substantial female population has osteopenia and osteoporosis after the age of 40 years.[24]

The analysis shows that factors such as BMI, Health status, life style, age, economic status and dietary patter plays important role to accelerate the level of T-score more than -1 in both group either premenopausal women or post-menopausal women.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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