



DIETARY CALCIUM INTAKE AND BONE MINERAL DENSITY IN PERIMENOPAUSAL AND POSTMENOPAUSAL WOMEN

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ABSTRACT

Introduction: Menopause, one of most challenging phase of a woman's life typically occurs in a woman's late 40's to early 50's. 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. One of the risk factors for bone loss, and thus the development of osteoporosis, is an inadequate dietary intake of nutrients important to bones. Dietary calcium, protein as well as phosphorus and vitamin D play an active role in bone metabolism. The aim of the present investigation was to study the association between dietary intake of calcium and bone mineral density in perimenopausal and postmenopausal women. **Methods:** The target population was 100 women-50 each in perimenopausal (Age 40years and above) and postmenopausal (Age 40-70 years) status. The dietary adequacy with respect to major minerals viz. calcium, phosphorus and magnesium was assessed using valid questionnaire. Diet survey was done with the help of 24 hours recall method. BMD at A.P. Spine (L1-L4), femoral neck, fore arm (left and right), was measured (G.E. Lunar US, Pencil Beam Scan). **Results:** The mean age at menopause was seen to be 49 years \pm 3.29. The calcium intake of subjects in both the groups was found to be grossly deficient and meeting only 50-60% of the requirement. Significant correlation existed between calcium intake and BMD at AP spine in the perimenopausal subjects. In contrast the correlation was found to be significant at all sites in postmenopausal subjects. **Conclusion:** It was concluded that environmental factors, diet, especially calcium intake, life style, physical exercise, and exposure to sunlight influence the BMD status in peri and postmenopausal women.

KEYWORDS : Calcium intake, Perimenopausal, Postmenopausal, Bone Mineral Density (BMD)

INTRODUCTION:

Nutrition, access to health care, healthy life style, physical exercise all these determine health status at any stage of life. With age, changes take place in the body system leading to various problems. Menopause is the most challenging phase for every woman. In women most dramatic changes occur around the age 45-50 with menopause. Menopause is the permanent cessation of menses resulting from ageing of ovaries leading to decline in the production of ovarian hormone-estrogen and progesterone. This decline in hormonal level leads to a number of physical and metabolic changes. The transition to menopause and the time approaching menopause are referred as 'perimenopause'. During this period the function of ovaries starts decreasing. There is a fluctuation in the levels of hormone estrogen, which has an important role in building new bone. Due to the decrease in estrogen levels during menopause women become susceptible to osteoporosis. Many women experience a significant loss of minerals from bones (Osteoporosis & Osteopenia) predisposing them to fractures of hip and vertebra. Such injuries result in loss of functions, disability and often death.

Calcium is the most abundant mineral found in our body maintaining the strength and structure of bones and teeth, along with certain critical metabolic functions [1] the serum level of which is tightly controlled by the parathyroid hormone, calcitonin, and vitamin D. [2,3] Dietary deficiency of calcium leads to osteoporosis [3,4] and calcium also plays a significant role in the pathogenesis of other diseases like metabolic syndrome [5,6] and cancer. [7] Various studies have shown that good dietary calcium and moderately increased physical activity, if maintained for long-term periods, considerably improve the mechanical competence of the skeletal system. [8,9]

The importance of menopause in family and society health is due to its complications. However these health complications could be postponed by preventive measures. It is necessary to recognize associated factors of menopause to provide appropriate awareness and guidance before and after menopause. The aim of the study was to investigate the association between dietary intake of calcium and bone mineral density in perimenopausal and postmenopausal women.

METHODS:-

The target population was 100 women-50 each in perimenopausal (Age 40 years and above) and postmenopausal (Age 40-70 years) status. The dietary adequacy of these women with respect to major minerals viz. calcium, phosphorus and magnesium was assessed. The study participants were selected by purposive sampling from private clinics (Gynaec and Orthopedic) and yoga centers located in West Nagpur.

Inclusion Criteria: Perimenopausal and Postmenopausal women who were ready to participate in the study and consented to comply with the investigation were included.

Exclusion Criteria: Women who were taking calcium supplementation, had surgical menopause, cancer sufferers and who refused to participate in the study were excluded.

Basic information regarding age, age at menopause, lifestyle, exposure to sunlight, and physical exercise was collected using a questionnaire schedule. Quantitative information on consumption of foods was obtained by 24 hours recall method with the aid of series of standard cups previously standardized for the given recipe. Nutrient intake for major minerals-calcium, phosphorus and magnesium was calculated using food composition tables [10] and percent adequacy were computed by comparing with recommended dietary allowances (RDA) for Indians (ICMR2010). The calcium sources and their frequency was assessed using food frequency questionnaire which contained food items rich in calcium as well as locally available, commonly consumed in this area. Subjects were asked to state the frequency of intake of each kind of food listed per day, once a week, twice a week, once per month and never.

Bone Mineral Density (BMD): The BMD of all subjects was assessed by Dual Energy X ray Absorptiometry (DEXA). BMD at A.P. Spine (L1-L4), femoral neck, fore arm (left and right), was measured (G.E. Lunar US, Pencil Beam Scan). The diagnosis of osteoporosis was done as per the WHO [11] criteria (Table 1) with the assistance of specialist.

Table 1: WHO Criteria for Diagnosis of Osteoporosis

T score	Diagnosis
-1	Normal
Between -1 and -2.5	Osteopenic
<-2.5	Osteoporotic

Statistical analysis: The collected data were categorized, tabulated and made ready for use. Results were reported as means, \pm standard deviation for quantitative parameters and percentages for qualitative parameters under study. Pearson's correlation test was applied to associate calcium intake with BMD 'T' scores in both perimenopausal and postmenopausal subjects. Inferences were drawn and the results discussed.

RESULTS AND DISCUSSION:

Age: In the present investigation 100 perimenopausal and postmenopausal women were investigated. Table no 2 shows age wise distribution of the subjects. Maximum perimenopausal women (94%)

belonged to the age group of 40-49 years, while most of the postmenopausal women (90%) were in the age range of 51 to 55 years. World Health Organization (WHO) defines menopause as the "permanent termination of menstruation as a result of the loss of ovarian activity". It is associated with the decrease in estrogen secretion that occurs physiologically due to loss of follicular functions. It occurs universally in all women who reach midlife. The timings of menopause as well as women's experience of menopausal symptoms vary between the populations. The mean age at menopause was seen to be 49 years ± 3.29. Agrawal [12] reported the mean age at menopause to be 49.66 years which was found to be nearly similar to the observation of present study.

Table No.2 Age wise Distribution of Perimenopausal and Postmenopausal subjects.

S. No.	Particulars	Perimenopausal Subjects (N=50)		Particulars	Postmenopausal Subjects (N=50)	
		Frequency	Percentage		Frequency	Percentage
1	Age Group (Years)			Age Group (Years)		
	40-44	23	46%	46-50	05	10%
	45-49	24	48%	51-55	18	36%
	Above >49	03	06%	Above 55	27	54%

Calcium Intake:

The calcium intake of subjects in both the groups was found to be grossly deficient (534.31±183.7 and 421.62 ±164.9 for perimenopausal and postmenopausal subjects respectively) and meeting only 50-60% of the requirement. The mean phosphorous and magnesium intakes observed were found to be within the recommended range of nutrients.

The data showed scanty use of calcium rich sources in the diet of both peri and postmenopausal subjects. Lack of awareness seems to be a factor for less use of most of the seeds which were rich sources of calcium and easily available. The use of leafy vegetables was also infrequent, except for curry leaves which however was used for seasoning of dals and curries. The importance of ragi as a good source of calcium was known to only 22% of postmenopausal subjects who

indicated incorporating the same in their diet once a week. The major percentage of subjects being vegetarian the use of non-vegetarian foods especially eggs as a source of calcium was not observed. Dairy products provide more calcium, protein, magnesium, potassium, zinc and phosphorus per calorie than any other food [13]. It was surprising to note that in the present study none of the subject was taking milk as a beverage regularly.

Results vividly points to the deficient intake of calcium in the diets of both perimenopausal and postmenopausal subjects. It was to be noted here that all the subjects were drawn from a fairly stable financial status and therefore the deficit intake of calcium, due to absence of calcium rich foods in their diets was because of lack of awareness. Jeffery Pradeep Raj[14] reported that daily calcium intake was below the RDA and the majority of postmenopausal women were inactive, indicating the need for better education regarding daily calcium intake.

It was obvious that majority of the subjects from both the groups were not aware about the dietary sources of calcium, requirement and importance of dietary calcium during this stage of life. Only 8% perimenopausal subjects and 19% postmenopausal subjects were aware about this. 52% perimenopausal and 68% postmenopausal subjects were aware about osteoporosis. Osteoporosis is a decrease in bone mineral density. Weight bearing exercises are essential in preventing osteoporosis. It was observed in the present investigation that majority of the subjects were housewives and were residing in flat schemes, had poor exposure to sunlight which is a rich and cheapest source of vitamin D. Vitamin D helps in absorption of calcium, the main source of vitamin D is sunlight. Exposure to sunlight at least for 25 minutes daily is essential. They considered doing household activities as exercise and hence were negligent about doing regular exercise. Datten Bangun [15] reported that only 8.07% of the postmenopausal women were performing exercise regularly.

Calcium Intake and BMD:

Table no 3&4 show the results of Pearson's correlation between mean calcium intake and BMD T scores assessed at different sites in perimenopausal and postmenopausal subjects respectively.

Table No. 3 Correlation of Mean Calcium Intake and BMD T Scores of Perimenopausal Subjects.

Mean Age (Years)	Mean Calcium Intake (In mgs)		BMD T Score at Different Sites				
			A.P. Spine	Femur Neck Left	Femur Neck Right	Forearm Left	Forearm Right
41.6±1.326 (N=23)	536.49±189.18		0.526± 1.25	-0.96 ±0.85	-0.79± 0.77	-0.64 ± 1.22	-0.83 ± 0.92
		r	0.47	0.3069	0.356	0.12	-0.021
		p	0.0236*	0.154	0.0953	0.597	0.924
47.2±1.493 (N=24)	542.09±174.79		-0.64±0.4924	-0.83 ± 0.87	-0.79±0.84	-0.75 ± 1.73	-1.3 ±1.07
		r	0.415	0.134	0.112	-0.143	0.0475
		p	0.0436*	0.531	0.603	0.505	0.825
51.33±0.58 (N=03)	455.3 ±267.54		0.23 ±0.98	-0.7 ±0.624	-0.80 ± 0.79	-2 ± 1.04	-0.77 ±0.57
		r	0.49	0.265	0.315	0.403	0.702
		p	0.674	0.829	0.796	0.7357	0.504

(* r- value significant at 0.05 level)

Mean calcium intake for different age categories of perimenopausal subjects was calculated and correlation (r) derived between mean calcium intake and BMD T scores at different sites. Perimenopausal women in the age range of 40-44 yrs. (mean age 41.6±1.326yrs) and age range 44-49 yrs. (mean age 47.2yrs.±1.493) had a mean dietary calcium intake (mgs.) of 536.49±189.18 and 542.09±174.79 respectively which was significantly correlated with the BMD T score at the A.P. Spine site. The correlation was insignificant at other sites. Mean BMD T scores of perimenopausal subjects revealed that the subjects with mean age 51.33yrs.±0.58yrs. (N=03), with mean dietary calcium intake of 455.3 ±267.54 mg had osteopenia at left forearm site (T score -2 ± 1.04). However the correlation between dietary intake of calcium and BMD T score was found to be insignificant.

Table No. 4 Correlation of Mean Calcium Intake and BMD T Scores of Postmenopausal Subjects.

Mean Age of Subjects (In Years)	Mean Calcium Intake (In mgs)		BMD T Score at Different Sites				
			A.P. Spine	Femur Neck Left	Femur Neck Right	Forearm Left	Forearm Right
48.6±1.67332 (N=05)	495.1± 195.5		-2.1 ± 1.36	-1.48 ±0.75	-1.48 ± 0.75	-1.96±1.91	-1.74±0.84
		r	0.87	0.497	0.61	0.2346	-0.36
		p	0.0491*	0.393	0.272	0.7040	0.552
53.38±1.243 (N=18)	500.6 ±191.5		-1.73± 1.32	-1.20± 1.27	-1.15 ± 1.14	-1.64± 1.45	-1.16 ±1.07
		r	0.60	0.74	0.79	0.54	0.396
		p	0.00855*	0.000495*	0.000098*	0.02142*	0.104
60.3±3.53 (N=27)	355.36±107.1		-2.31 ±1.04	-1.57 ±0.75	-1.48 ± 0.85	-2.26 ± 1.47	-2.24 ± 1.39
		r	0.58	0.21	0.23	0.52	0.3974
		p	0.001512*	0.29	0.25	0.00477*	0.40*

(* r- value significant at 0.05 level)

Observation from the table (Table No. 4) show that BMD T scores of postmenopausal women had osteopenia at all the sites. The correlation of dietary intake of calcium with BMD scores was found to be significant at A.P. Spine (T score -2.1 ± 1.36 , $p=0.0491$) for mean age 48.6 ± 1.67332 (N=05), with mean dietary calcium intake of 495.1 ± 195.5 (mgs). Though the intake was inadequate the correlation was insignificant at all sites for this age group. Postmenopausal women of age range 51-55 yrs. (mean age 53.38 ± 1.243) and mean dietary intake of calcium 500.6 ± 191.5 mg (N=18) was significantly correlated with the BMD scores at all the sites except at right forearm site. The correlation of dietary intake of calcium (355.36 ± 107.1) with BMD scores was found to be significant at A.P. Spine (T score -2.31 ± 1.04 , $p=0.001512$) right forearm (T score -2.26 ± 1.47 , $p=0.00477$) and left forearm (T score -2.24 ± 1.39 , $p=0.40$).

The data on mean calcium intake reflects that there was a decrease in mean intake with increase in age in both the groups of subjects. The calcium intake of subjects was inadequate. The inadequacy was found to increase with increase in age group. Significant correlation existed between calcium intake and BMD at AP Spine in the perimenopausal subjects. In contrast the correlation was found to be significant at all sites in postmenopausal subjects. The mean T score value observed in postmenopausal women at all different sites strongly pointed out to the presence of osteopenia indicating changes in bone structure.

In concordance with this study Gandhi and Shukla [16] in their study of women aged 40 years and above, found that out of 200 women, 34% had osteopenia and 8% had osteoporosis. In women above 60 years, there was an almost 100% incidence of either osteopenia or osteoporosis.

Studies conducted by Hezazi [17] on 97 postmenopausal osteoporotic women show high T scores of lumbar spine femoral neck and total hip indicative of osteoporosis. The authors report that major percentage of their subjects had osteoporosis on lumbar spine while a lesser percentage of femoral neck on hip regions. The results of present study are comparable to the study of Hezazi [17]. Studies on postmenopausal women conducted by Tranquilli [18] have shown a strong correlation between reduced dietary intake of calcium phosphorous and magnesium in osteoporotic women and BMC. In their study Calcium and magnesium intake were below RDA in normal women. The postmenopausal subjects in the present study had a low calcium intake (421.62 ± 164.9 gms) which reflected a significant correlation to BMD as evident by 'T' scores indicating osteopenia and osteoporosis. The effect was however less pronounced in perimenopausal subjects who had a comparatively higher calcium intake (534.31 ± 183.7 gms). Usi Rasi [19] stated that high calcium intake and increased body weight seem to retard or prevent premenopausal bone loss from the proximal bone loss from the proximal femur and distal radius. Potential causes for low BMD include insufficient level of physical activity, low body weight and hormonal abnormalities; factors which are interrelated. Postmenopausal women are the most vulnerable group for osteoporotic fractures because of estrogen deficiency particularly in the wrist, lumbar spine and hip.

CONCLUSION:

Menopause is an important period in a women's life. Her body is going through many changes that can affect her physical as well as her social health. It was concluded that environmental factors especially calcium intake, life style, physical exercise, and exposure to sunlight influence the BMD status in postmenopausal women

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