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Study of osteoporosis in postmenopausal woman and its relation to vitamin D deficiency and daily calcium intake.

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ABSTRACT

Objective: We evaluated the combined effects of vitamin D and daily calcium intake on bone mineral density (BMD) and osteoporosis in the postmenopausal women.

Methods: This study is a cross-sectional record based study consisting of 1,921 postmenopausal women aged 45 to 70 years without thyroid dysfunction, from 2006 to 2012.

Results: The BMD divided according to serum 25(OH)D and daily calcium intakes were not statistically different among the groups. However, when both daily calcium intake and serum 25(OH)D were not sufficient, risk of osteopenia and osteoporosis showed significant increase in both femur neck and lumbar spine (odds ratio [OR] 2.242, *P*=0.006; OR 3.044, *P*=0.001; respectively).

Conclusion: The combined effects of insufficient daily calcium intake and vitamin D deficiency may cause low BMD and increase in prevalence of osteopenia and osteoporosis in the postmenopausal women aged 45 to 70 years.

KEYWORDS : Bone density, Calcium intake, Menopause, Osteoporosis, Vitamin D

Introduction

The life expectancy of women is increasing, but the average age of women at the time of menopause is about 50 years. According to the 2015 World Health Organization's annual report, global life expectancy at birth in 2015 was 71.4 years and for Indian women its 69.9 years [1]

As women gets older, the prevalence of complications such as osteoporosis and bone fractures increase, and these could be considerable public health problem which cause a lot of social cost [2]. Postmenopausal osteoporosis occurs very commonly because of age related bone loss [3]. In previous studies, estrogen depletion are resulted from an imbalance in bone modeling and this can lead to an accelerated phase of bone loss and an efflux of bone-derived calcium to the extracellular fluids [4]. The increased fragility of bone due to changes in metabolism has also been investigated in experimental studies in rats and women [5,6]. These conditions are closely associated with osteoporosis and fractures that require major surgery. These complications can also cause women to be restricted to bed rest which consequently reduces their quality of life after menopause.

Therefore, the present study aimed to assess the combined effects of one's daily calcium intake and vitamin D level on the BMD and prevalence of osteopenia and osteoporosis in indian postmenopausal women aged 45 to 70 years.

Materials and methods

This study was conducted under the Dept. of Obstetrics and Gynaecology of a tertiary hospital taken place from 2006 to 2012. Using rolling survey sampling, subjects participated in a complex, stratified, probability cluster survey of a representative sample.

Results

Among 1921 participants, numbers of people included in the group 1 to 6 were 669, 421, 408, 238, 97 and 88, respectively.

Table 1 shows comparisons of BMD in femur neck and lumbar spine. Among participants taking moderate amounts of calcium (400≤ calcium <800 mg/day), femur neck BMD showed tendency of difference according to the status of serum 25(OH)D (*P*=0.088).

Contrary to table 1, table 2 shows comparisons of femur neck and lumbar spine BMD according to amounts of daily calcium intake within vitamin D sufficient and insufficient groups. There were no significant differences among the groups in both serum 25(OH)D <20 ng/mL and ≥20 ng/mL groups in femur neck BMD (*P*=0.508, *P*=0.311, respectively).

Table 3 shows OR for osteopenia and osteoporosis of femur neck and lumbar spine according to daily calcium intake and serum vitamin D levels. The logistic regression model was adjusted by age, BMI, physical activity, smoking history, history of estrogen therapy and history of fracture.

Discussion

From the results obtained we concluded that a lower daily calcium intake and insufficient serum vitamin D level may result in a low BMD in both femur neck and lumbar spine, with higher prevalence of osteopenia and osteoporosis in postmenopausal women. Lumbar spine BMD seems to be more affected by both insufficient daily calcium intake and serum vitamin D level than femur neck BMD. Moreover, although daily calcium is sufficiently taken, the lumbar spine BMD could be affected negatively when serum vitamin D is insufficient.

The effects of vitamin D and calcium are known to be considerable factors for maintaining BMD levels [13,14]. Although there is no consensus on optimal serum levels of 25(OH)D, most experts consider 25(OH)D less than 20 ng/mL to be vitamin D deficiency [15,16,17,18,19]. When serum 25(OH)D is deficient, it is known to affect bone metabolism through osteoclastic bone resorption and bone loss induced by increase in parathyroid hormone secretion as well as decrease in muscle mass and function [17,20]. Calcium is a mineral component which influences the skeletal and smooth muscles, which 99% is stored in the bones in the form of hydroxyapatite. Deficient dietary consumption of calcium leads to lower bone mineral content and BMD, which in long-term leads to osteopenia and osteoporosis [21].

Previously, in one study reported that treatment of vitamin D deficiency in asymptomatic people might reduce mortality risk in elderly people and risk for falls but not fractures [27]. It emphasizes the importance of adequate level of serum vitamin D, but it is concluding that sufficient intakes of vitamin D would not decrease the fracture risk. Contrarily, our study showed the importance of maintaining adequate level of serum vitamin D by showing the increase risk of osteopenia and osteoporosis in lumbar spine, in a subgroup having insufficient amounts of serum 25(OH)D level with adequate daily calcium intake, when compared to the reference group.

One of the drawbacks of this study is that this investigation was retrospective cross-sectional design that direct relationship between the variables could not be obtained through this study. Further studies will be needed to obtain more precise values for serum vitamin D levels and amounts of dietary calcium intakes.

The vitamin D and daily calcium intake are significant variables that affect the BMD in both femur neck and lumbar spine in postmenopausal women. Also, although daily calcium intake is sufficient, the lumbar spine BMD could be affected negatively when serum vitamin D is not sufficient, increasing the risks of osteoporosis. Therefore, supplementing vitamin D and calcium for postmenopausal women would be crucial for preventing osteoporosis and fracture.

List of tables:

TABLE 1: Differences in BMD of the femur neck and lumbar spine (subgroup analysis according to daily calcium intake)

	Ca[a] <400 mg			400 mg≤ Ca[a] <800 mg			Ca[a] ≥800 mg		
	25(OH)D<20 ng/mL	25(OH)D≥20 ng/mL	*P*-value	25(OH)D<20 ng/mL	25(OH)D≥20 ng/mL	*P*-value	25(OH)D<20 ng/mL	25(OH)D≥20 ng/mL	*P*-value
Femur neck BMD	0.610 (0.100)	0.654 (0.099)	0.351[b]	0.626 (0.107)	0.655 (0.095)	0.088[b]	0.624 (0.967)	0.658 (0.102)	0.892[b]
Normal	129 (19.3)	117 (27.8)	<0.001[c]	93 (22.8)	75 (31.5)	0.048	21 (21.6)	28 (31.8)	0.057[c]
Osteopenia	380 (56.8)	256 (60.8)		241 (59.1)	141 (59.2)		59 (60.8)	52 (59.1)	
Osteoporosis	160 (23.9)	48 (11.4)		74 (18.1)	22 (9.3)		17 (17.6)	8 (9.1)	
Lumbar BMD	0.765 (0.115)	0.822 (0.117)	0.388[b]	0.790 (0.132)	0.824 (0.132)	0.458[b]	0.798 (0.126)	0.830 (0.132)	0.487[b]
Normal	91 (13.6)	125 (29.7)	0.003[c]	98 (24.0)	44 (18.5)	<0.001	21 (21.6)	27 (30.7)	0.017[c]
Osteopenia	341 (51.0)	198 (47.0)		163 (40.0)	124 (52.1)		50 (51.6)	44 (50.0)	
Osteoporosis	237 (35.4)	98 (23.3)		147 (36.0)	70 (29.4)		26 (26.8)	17 (19.3)	

Age and body weight were adjusted.

BMD, bone mineral density; Ca, calcium; 25(OH)D, 25-hydroxyvitamin D.

[a]Daily calcium intake; [b]Analysis of covariance; [c]Chi-square test.

TABLE 2: Differences in BMD of the femur neck and lumbar spine (subgroup analysis according to serum vitamin D levels)

	25(OH)D <20 ng/mL				25(OH)D ≥20 ng/mL			
	Ca[a] <400 mg	400 mg ≤ Ca[a] <800 mg	Ca[a] ≥800 mg	*P*-value	Ca[a] <400 mg	400 mg ≤ Ca[a] <800 mg	Ca[a] ≥800 mg	*P*-value
Femur neck BMD	0.610 (0.100)	0.626 (0.107)	0.624 (0.967)	0.508[b]	0.654 (0.099)	0.655 (0.095)	0.658 (0.102)	0.311[b]
Normal	129 (19.3)	93 (22.8)	21 (21.6)	0.907[c]	117 (27.8)	75 (31.5)	28 (31.8)	0.673[$]
Osteopenia	380 (56.8)	241 (59.1)	59 (60.8)		256 (60.8)	141 (59.2)	52 (59.1)	
Osteoporosis	160 (23.9)	74 (18.1)	17 (17.6)		48 (11.4)	22 (9.3)	8 (9.1)	
Lumbar BMD	0.765 (0.115)	0.790 (0.132)	0.798 (0.126)	0.624[b]	0.822 (0.117)	0.824 (0.132)	0.830 (0.132)	0.087[b]
Normal	91 (13.6)	98 (24.0)	21 (21.6)	0.907[c]	125 (29.7)	44 (18.5)	27 (30.7)	0.015[c]
Osteopenia	341 (51.0)	163 (40.0)	50 (51.6)		198 (47.0)	124 (52.1)	44 (50.0)	
Osteoporosis	237 (35.4)	147 (36.0)	26 (26.8)		98 (23.3)	70 (29.4)	17 (19.3)	

Age and body weight were adjusted.

BMD, bone mineral density; 25(OH)D, 25-hydroxyvitamin D; Ca, calcium.

[a]Daily calcium intake; [b]Analysis of covariance; [c]Chi-square test.

TABLE 3: The odds ratio of osteopenia and osteoporosis of femur neck and lumbar spine according to daily calcium intake and serum vitamin D level.

	Femur neck		Lumbar spine	
	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value
Ca[a] ≥800 mg & 25(OH)D ≥20 ng/mL	Reference		Reference	
Ca[a] ≥800 mg & 25(OH)D <20 ng/mL	1.820 (0.888–3.729)	0.102	2.993 (1.372–6.530)	0.006
400 mg≤ Ca[a] <800 mg & 25(OH)D ≥20 ng/mL	1.330 (0.706–2.508)	0.377	2.213 (1.090–4.492)	0.028
400 mg≤ Ca[a] <800 mg & 25(OH)D <20 ng/mL	2.167 (1.195–3.932)	0.011	2.721 (1.382–5.359)	0.004
Ca[a] <400 mg & 25(OH)D ≥20 ng/mL	1.201 (0.657–2.194)	0.552	1.980 (1.001–3.915)	0.050
Ca[a] <400 mg & 25(OH)D <20 ng/mL	2.242 (1.256–4.003)	0.006	3.044 (1.569–5.906)	0.001

Adjusted values; age, body mass index, physical activity, smoking history, history of estrogen therapy, history of fracture.

OR, odds ratio; CI, confidence interval; Ca, calcium; 25(OH)D, 25-hydroxyvitamin D.

[a]Daily calcium intake.

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