Original Article

Vitamin D and bone mineral density status among postmenopausal Bangladeshi women

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Abstract

Background and objectives: Low vitamin D is a global problem in all age groups as is osteoporosis in postmenopausal women. The present study was carried out in an urban hospital to assess serum 25-hydroxyvitamin D [25(OH)D] level and bone mineral density (BMD) in postmenopausal women (PMW) and to evaluate correlation between serum 25(OH)D levels and BMD.

Methods: A single center cross-sectional study was conducted among 133 apparently healthy PMW aged 45 years and above with the history of complete cessation of menstruation over a period of more than 1 year. Serum 25(OH)D, BMD and serum intact parathyroid hormone (iPTH) were determined. Patients having both vitamin D and BMD values were analyzed for correlations. Similarly, correlation of vitamin D, iPTH and BMD were determined.

Results: Among the study population, 63 (47.4%) had deficient (<20 ng/ml), 46 (34.6%) had insufficient (20-30ng/ml) and 24(18%) had sufficient (30-100ng/ml) levels of serum 25(OH)D. Among the 121 patients whose BMD was done, 52 (43.0%) and 60 (49.6%) had osteoporosis and osteopenia respectively. Serum iPTH levels were normal in 34 (89.5%) patients. The proportion of osteopenia and osteoporosis in vitamin D deficient group were 44.1% and 50.8% and in insufficient group 47.5 and 45.0%, respectively. Age had significant negative correlation with BMD value (r=-0.246, p=.005) and significant positive correlation with serum iPTH (r=0.358, p=.024). There was no statistically significant influence of serum 25(OH)D or iPTH on occurrence of osteoporosis (P=0.322 and P=0.592 respectively).

Conclusion: A large proportion of postmenopausal women had low vitamin D levels and as well as osteopenia and osteoporosis. Low vitamin D level coexisted with low BMD. However, there was no correlation between serum 25(OH)D levels and BMD status.

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Introduction

It is well known that postmenopausal women (PMW) are prone to suffer from vitamin D deficiency and osteoporosis [1]. A study conducted among 18-33 years old Bangladeshi woman reported low vitamin D levels in 81% women despite being exposed to sun for more than 20 hours per week [2]. Low vitamin D status was observed among female Bangladeshi garment workers aged 20-40 years [3]. Few other studies also reported low vitamin D status in selected Bangladeshi women population [4,5].

Vitamin D deficiency is associated with low bone mineral density (BMD) leading to osteopenia or

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osteoporosis in adults. The deficiency is believed to cause secondary hyperparathyroidism, leading ultimately to bone loss by increased bone turnover [6,7].

There are reports of co-existence of vitamin D deficiency and low BMD among postmenopausal women of many countries of the world [8-10]. There is little information about vitamin D status and osteoporosis in Bangladeshi postmenopausal women. There is one study about the status of BMD in Bangladeshi women. The study showed, 43.6% and 5.5% of 16–45 years old women, and 40.7% and 41.8% of 46–65 years old women had osteopenia and osteoporosis respectively [11].

In view of the above, the present study was undertaken to determine the levels of serum 25-hydroxyvitamin D [25(OH)D], intact parathyroid hormone (iPTH) and BMD in postmenopausal women (PMW) and the correlation among them.

Materials and methods

Study population: This cross-sectional observational study was conducted on 133 healthy postmenopausal women aged 45 years and above with the history of complete cessation of menstruation over a period of more than 1 year. Participants were enrolled as they presented for routine medical care to an urban hospital in Dhaka city from July 2016 to June 2017. Relevant data were obtained in a predesigned questionnaire. All women were from urban/semi-urban locality. They were included irrespective of any vitamin D or calcium intake and exposure to sunlight per day. A comprehensive physical examination was done. Women with a major medical illness such as hepatic dysfunction, significant thyroid dysfunction, renal disease, parathyroid or any other metabolic bone disorders and malignancies were excluded from the study. Women on steroid therapy or any anti-osteoporotic medications like hormone replacement therapy or bisphosphonates were also excluded from the study. All participants were enrolled in the study after obtaining informed consent.

Biochemical measurements: Serum 25(OH) D was measured by automated chemiluminescence immunoassay (Dimension EXL 200/Advia Centaur XP). Women were classified based on vitamin D levels as deficient (<20 ng/ml); insufficient (20–30 ng/ml); and sufficient (>30-100 ng/ml) [12]. Serum iPTH was measured by automated chemiluminescence immunoassay (Liaison Diasorin, Italy). Level <14.5 pg/ml was taken as low, 14.5 to 87.1pg/ml as normal and >87.1pg/ml as high.

Bone mineral density: BMD was assessed with dual-energy X-ray absorptiometry at lumbar spine and neck of femur (either left or right). Bone mineral density values were interpreted as T-score and lowest T-score at any of these sites was taken as the representative T-score. T-score was calculated as the difference between the measured BMD of the patient and the expected bone density value in a normal young person (YN) divided by the population SD. T-score$=$ (BMD$-$YN)/SD. Normal T-score was defined as >-1, osteopenia -1 to -2.5 and osteoporosis as <-2.5 [13,14].

Statistical analysis: Analysis was performed with the use of IBM SPSS Statistics (version 20.0.0), USA. Results are presented as absolute values, percentage and mean $\pm$ standard deviation. Pearson's coefficient (r) was calculated for the correlation between continuous variables. Logistic regression was used to find out the influences of varies variables on occurrence of osteoporosis.

Results

A total of 133 post-menopausal women were included in the study. The age ranged from 45-90 years, mean 63.9 $\pm$9.1years. Out of 133 women, 77 (57.9%) and 56 (42.1%) belonged to 45-65 years and 66-90 years age group respectively. The overall results of serum vitamin D, iPTH and BMD T-score are shown in Table-1. Out of 133 women, only 24 (18%) had normal vitamin D level (30-100 ng/ml) while 47.4% and 34.6% were in deficient and insufficient categories respectively (Table-1). The mean vitamin D level of 133 cases was 22.1 ± 11.3 ng/ml. Of the 133 cases, BMD was measured in 121 cases. According to the T-score of BMD measurement test, 42.5% and 49.6% of 121 cases had osteopenia and osteoporosis respectively. Of the 133 cases, serum iPTH was tested in 38 cases and majority (34/38, 89.5%) had normal levels of iPTH.

Table-1: *Vitamin D, BMD T-score and iPTH levels of the study population*

Parameters	Number	%
Age group		
45-65 yrs	77	57.9
66-90 yrs	56	42.1
Vitamin D levels (ng/ml) (n=133)		
Sufficiency 30-100	24	18.0
Insufficiency 20-30	46	34.6
Deficiency <20	63	47.4
BMD T-score (n=121)		
Normal (> -1)	9	7.4
Osteopenia (-1 to -2.5)	52	43.0
Osteoporosis (< -2.5)	60	49.6
iPTH level (pg/ml) (n=38)		
Normal (14.5-87.1)	34	89.5
High (> 87.1)	3	7.9
Low (< 14.5)	1	2.6

Note: *Out of total 133 cases, BMD and iPTH were measured in 121 and 38 cases respectively.*

Table-2 shows that 81.9% (deficient 48.1% and insufficient 33.8%) and 84.1% (deficient 46.4% and insufficient 37.7%) of study population belonging to 45-65 and 66-90 years age group respectively had low vitamin D levels. There was no significant ($p>0.05$) difference of any category of vitamin D levels between the two age groups.

Table-2: *Serum vitamin D level in different age groups of study population (n=133)*

Age group yrs	Number	Vitamin D status		
		Deficiency N (%)	Insufficiency N (%)	Sufficiency N (%)
45-65	77	37 (48.1)	26 (33.8)	14 (18.2)
66-90	56	26 (46.4)	20 (35.7)	10 (17.9)

Osteopenia and osteoporosis were present in 47.1% and 47.7% of study population aged between 45-65 years while only 7.1% had normal BMD T-score. The comparative rate of osteopenia and osteoporosis among 66-90 years age group was 37.3% and 54.9% respectively (Table-3). In Pearson's correlation analysis, age had significant negative correlation with BMD values ($r= -0.246$, $p=.005$).

The rate of osteopenia and osteoporosis was 44.1% and 50.8% in vitamin D deficient and 47.5% and 45% among insufficient groups. There were 31.8% and 54.5% osteopenia and osteoporosis respectively among women with sufficient level of vitamin D (Table-4). No significant correlations were found between vitamin D and BMD values ($r= -0.056$, $p=.579$). No significant difference regarding occurrences of osteopenia and osteoporosis were observed among women with normal vitamin D compared to that of women with deficient or insufficient levels.

Table-3: *Status of BMD in different age groups of study population (N=121)*

Age group (yrs)	Number	BMD result					
		Normal		Osteopenia		Osteoporosis	
		Number (%)	Mean T-score	Number (%)	Mean T-score	Number (%)	Mean T-score
45-65	70	5 (7.1)	-0.63±0.22	33 (47.1)	-1.99±.34	32 (47.7)	-3.23±.94
66-90	51	4 (7.8)	-0.30±1.12	19 (37.3)	-1.83±.41	28 (54.9)	-3.27±.68

Note: *$p>0.05$ compared between two age groups for osteopenia and osteoporosis.*

Table-4: *Distribution of BMD categories of study population according to vitamin D level (n=121)*

Vitamin D level (ng/ml)	Number	BMD result					
		Normal (T=>-1)		Osteopenia (T=-1 to -2.5)		Osteoporosis (T=<-2.5)	
		Number (%)	Mean T- score	Number (%)	Mean T-score	Number (%)	Mean T- score
Deficiency <20	59	3 (5.1)	0.30±.68	26 (44.1)	-1.98±.37	30(50.8)	-3.41±.96
Insufficiency 20-30	40	3 (7.5)	-0.74±22	19 (47.5)	-1.95±40	18(45.0)	-3.00±.57
Sufficiency 30-100	22	3 (13.6)	-0.75±.21	7 (31.8)	-1.85±.35	12(54.5)	-2.98±.50

Serum iPTH levels in women with normal and low vitamin D levels (deficient and insufficient) are shown in Table-5. About 84% to 94% of women with different grades of vitamin D level had normal serum iPTH. By Person's analysis no significant correlation was found between vitamin D and serum iPTH levels (r=-0.302, p=.066). Also, in logistic regression model no statistically significant influence of vitamin D or serum iPTH were found on the occurrence of osteoporosis (p=0.322, p= 0.592) respectively.

Table-5: *Serum iPTH levels in women with different grades of Vitamin D status (n=38)*

Vitamin D level (ng/ml)	Serum iPTH*		
	Normal N (%)	High N (%)	Low N (%)
Deficiency (<20)	11 (84.6)	2 (15.4)	0
Insufficiency (20-30)	16 (94.1)	1 (5.9)	0
Sufficiency (30-100)	7 (87.5)	0	1 (12.5)

Discussion

The present study investigated the association of serum 25(OH) D levels and BMD in healthy PMW irrespective of dietary intake and sun exposer. Many studies have showed presence of hypovitaminosis D in people living in countries where sunlight is not a problem at all [2-5,15-17]. Vitamin D deficiency is thought to be an important risk factor for the development of osteoporosis. In our study we found high prevalence (82%) of hypovitaminosis D, which was consistent with other studies in Bangladesh and other Asian countries [2-5,16,18,8]. Prevalence of hypovitaminosis D in PMW was found to be 47% in Thailand, 49% in Malaysia, 90% in Japan and 92% in South Korea [19].

Around 40-50 % patients were either osteopenic or osteoporotic in low vitamin group in our study. Osteoporosis was more among relatively older patients. Interestingly, patients among the sufficient vitamin D group also suffered from significant osteopenia and osteoporosis. Begum *et al* [11] showed that even the younger Bangladeshi women had low BMD and 43.6% and 5.5 % of 16–45 year-old women had osteopenia and osteoporosis respectively. In our study, there was no correlation between serum 25(OH)D levels and BMD. Similar studies done in various part of the world demonstrated that BMD had no significant relation to serum 25(OH)D status [8,20-23]. However, a few studies have shown a positive correlation of serum 25(OH)D levels and BMD [24-26].

The high prevalence of vitamin D deficiency in Bangladesh may be due skin complexion, poor sun exposure (due to clothing), low milk intake, and lack of vitamin D fortification program despite availability of abundant sunlight. The association between 25(OH)D levels and BMD is still a debatable issue. These incongruous results regarding relationship of vitamin D and BMD status might be due to differences in population, age group and the vitamin D levels used to define deficiency and insufficiency in different studies.

In this study, age had significant positive correlation with iPTH, Chapuy et al found the same correlation in 124 normal subjects aged 20 to 90 years [27]. Probably with increasing age there is decreased calcium absorption resulting in secondary hyperparathyroidism When vitamin D falls below the lower physiological limit, iPTH level progressively rises, at the same time iPTH has a positive correlation with osteoporosis in postmenopausal woman [28]. However, we found no statistically significant association between vitamin D and iPTH or iPTH and osteoporosis. This can be explained by the smaller number of subjects tested for iPTH in current study; however other factors may also contribute. Sahota et al in a prospective study of 30 patients found a blunting response of iPTH to vitamin D deficiency in magnesium depleted patients [29].

The limitations of our study were the small sample, and exclusion of history of dietary habit. So multicentral, large scale study may provide more light into the occurrence of the low vitamin D level and low BMD status in our country.

Vitamin D deficiency and osteoporosis are highly prevalent in post-menopausal Bangladeshi women. However, we found no correlation between vitamin D deficiency and osteoporosis in our study population as with many others. Although a direct relationship could not be established between 25(OH)D and BMD, vitamin D deficiency coexisted with low BMD in our study. We should emphasize on the role of adequate intake of

calcium, hormone replacement and use of bisphosphonates for the management of osteoporosis in postmenopausal women along with adequate vitamin D intake.

Authors' contribution

AKMSA and WMMH designed the study, did data analysis, literature search and drafted the manuscript, KNU supervised the study, did data collection and revised the manuscript, FAA did data analysis and revised the manuscript, FA, HFH, SRA and MAR reviewed the manuscript, edited and had intellectual contribution to the manuscript

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Conflicts of interest

There are no conflicts of interest.

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