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RESEARCH ARTICLE

Study of Vitamin D Status among Postmenopausal Women

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ABSTRACT

Aim: To evaluate vitamin D, serum calcium, and serum phosphorus levels in postmenopausal women attending gynecology outpatient department in Lady Goschen and Kasturba Medical College Attavar hospitals.

Objective: To study the prevalence of vitamin D deficiency among the studied group. To correlate vitamin D levels with diet and environmental factors.

Materials and methods: The study was conducted in 100 postmenopausal women attending Lady Goschen hospital and Kasturba Medical College Attavar hospital, Mangaluru. It was a hospital-based, prospective cross-sectional study conducted over the period between August 2014 and June 2016. Levels of vitamin D and serum calcium and phosphorus were assessed in them.

Results: A total of 11% were found to have vitamin D deficiency, 38 and 48% had insufficient levels and sufficient levels of vitamin D respectively, 53% had normal levels of serum calcium, and 47% had inadequate levels. About 70% were found to have normal levels of serum phosphorus and 24% had inadequate levels. Dietary intake was found to be inadequate in 61% of the studied population. Serum calcium and phosphorus deficiency had significant corelation with vitamin D deficiency. Also significant corelation was noted with sun exposure and dietary intake in relation to vitamin D. No corelation was established between hypertension, diabetes and vitamin D.

Conclusion: This study helped us to assess basal levels of vitamin D, serum calcium, and serum phosphorus among postmenopausal women, giving us an idea regarding prevalence of vitamin D deficiency among South Indian postmenopausal women. We should consider counseling all postmenopausal patients regarding the benefit of vitamin D supplementation, adequate dietary intake, and sun exposure.

Keywords: Serum calcium, Serum phosphorus, Sun exposure, Vitamin D.

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INTRODUCTION

Vitamin D belongs to a group of fat-soluble secosteroids which helps in increasing intestinal absorption of calcium, iron, magnesium,phosphate, and zinc. In humans, vitamin D_3 (also known as cholecalciferol) and vitamin D_2 (ergocalciferol) are important compounds. Cholecalciferol and ergocalciferol can be ingested from the diet and from supplements.

Synthesis of vitamin D (specifically cholecalciferol) in the skin is dependent on sun exposure (specifically UVB radiation) which is an important major natural source.[1]

Vitamin D otherwise known as 'Sunshine Vitamin', is essential for humans. Vitamin D plays an important role in calcium homeostasis and bone metabolism.

Environmental (latitude, season, time of day, ozone and clouds, reflectivity of the surface) and personal (skin type, age, clothing, and use of sunscreen lotions) are the two major factors influencing the synthesis of vitamin D in the body.

Vitamin D_3 is synthesized in human skin after photoconversion of 7-dehydrocholesterol to pre-vitamin D_3, which then isomerizes to vitamin D_3 under the influence of UVB radiation from sunlight. Foods that naturally contain vitamin D are oily fishes (salmon, mackerel, and cod liver oil), egg, milk, and margarine.[2]

Vitamin D deficiency prevails in epidemic proportions all over the Indian subcontinent, with a prevalence of 70 to 100% in the general population.[2]

The onset of menopause comes with a number of health challenges for women. These include increased risk of osteoporosis, muscle weakness, cardiovascular disease, colorectal and breast cancer, diabetes, infections, and neurologic diseases.

The identification of vulnerable population is important in clinical practice because vitamin D deficiency is readily amenable to dietary vitamin D and calcium supplementation.

The most reliable marker of vitamin D status is the serum concentration of 25-hydroxy vitamin D (25(OH)D).[1]

However, there are several studies on vitamin D status but not many studies among postmenopausal women.

Therefore, this study evaluates vitamin D level among postmenopausal women and its correlation with diet and environmental factors.

Vitamin D deficiency is a preventable disorder but is a common and an important public health problem faced among the female population, especially postmenopausal women.

AIMS AND OBJECTIVES

- To evaluate vitamin D, serum calcium, and serum phosphorus levels in postmenopausal women attending the gynecology outpatient department in Lady Goschen Hospital and Kasturba Medical College Attavar.
- To study the prevalence of vitamin D deficiency among the studied group.
- To correlate vitamin D levels with diet and environmental factors.

MATERIALS AND METHODS

The study was conducted in Lady Goschen hospital and Kasturba Medical College Attavar hospital, Mangalore, over the period between August 2014 and June 2016. It is a hospital-based, prospective cross-sectional study.

Subjects who satisfy the inclusion criteria, exclusion criteria, and who gave consent were included in the study.

Initial information about the study was given to the women and written informed consent was obtained.

Inclusion Criteria

- Postmenopausal women above 45 years of age.

Exclusion Criteria

- Postmenopausal women with known hepatic or renal diseases.
- Postmenopausal women with known malabsorption syndromes or gastric banding surgeries.
- Postmenopausal women on drugs like anticonvulsants, thiazide diuretics, steroids, bisphosphonates, estrogen or progesterone or selective estrogen receptor modulator, which are known to cause vitamin D deficiency.
- Women taking vitamin D and calcium supplements for the last 6 months.

Dietary intake of serum calcium and phosphorus was documented by dietary recall method. Blood samples for measurement of serum calcium, serum phosphorus, and 25(OH)D levels were collected from the subjects from the most accessible peripheral vein under aseptic precautions.

The sample was centrifuged and stored at –20°C until assayed. The 25(OH)D levels was measured by enzyme-linked immunosorbent assay.

Normal values for these variables at our lab:

Serum calcium: 8.5–10.5 mg/dL

Serum phosphorus: 2.5–4.5 mg/dL

Sun exposure was considered adequate based on exposure for 15 min or more weekly four times a week.

Diet was considered adequate or not based on the following:

Recommended dietary allowance (RDA) of calcium: 1,200 mg/dL

RDA of phosphorus: 700 mg/dL

Reference range for vitamin D according to Kasturba Medical College lab values was taken as follows:

Level	*Reference range*
Deficient	<10 ng/mL
Insufficient	10–30 ng/mL
Sufficient	30–100 ng/mL
Intoxication	>100 ng/mL

RESULTS

A total of 100 postmenopausal women who fulfilled the inclusion criteria were taken for the study as mentioned earlier.

Patients were categorized to have deficient, insufficient, sufficient, and toxic levels of vitamin D based on the reference range given. Also, based on the questionnaire, patients were categorized to have adequate or inadequate dietary intake and sun exposure. Vitamin D levels were corelated with diet, environmental factors, and associated comorbidities.

Maximum patients were in the age group of 51 to 60 years, i.e., 51% and the least being above 70 years (Table 1).

Most of the patients of the study population were postmenopausal for 5 to 10 years, accounting for 37% (Table 2).

Those with 5 to 10 years of menopause were found to be the highest among the studied population and among them 45.5% had vitamin D deficiency.

Table 1: Distribution of study population according to age

Age (years)	*Frequency*	*n%*
46–50	15	15
51–60	51	51
61–70	26	26
Above 70	8	8
Total	100	100

Table 2: Distribution of study population according to the number of postmenopausal years

	No. of years	*Frequency*	*Percent*
Postmenopausal years	2 years and below	19	19
	3–5	21	21
	5–10	37	37
	Above 10	23	23
	Total	100	100

Table 3: Relation between number of postmenopausal years and vitamin D

		Vitamin D				
		Deficient	*Insufficient*	*Sufficient*	*Intoxication*	*Total*
Postmenopausal years	2	3	7	8	1	19
	3–5	2	2	16	1	21
	5–10	5	17	14	1	37
	>10	1	12	10	0	23
	Total	11	38	48	3	100

Fisher exact test p = 0.044, sig

Table 4: Serum calcium levels among the studied popuation

		Frequency	*Percent*
Serum calcium	Low	47	47
	Normal	53	53
	Total	100	100

Table 5: Serum phosphorus levels among the studied population

		Frequency	*Percent*
Serum phosphorus	Low	24	24
	Normal	70	70
	High	6	6
	Total	100	100

Table 6: Levels of vitamin D among the studied population

		Frequency	*Percentage*
Vitamin D	Deficient	11	11
	Insufficient	38	38
	Sufficient	48	48
	Intoxication	3	3
	Total	100	100

Table 7: Vitamin D in relationship with serum calcium and serum phosphorus

		Deficient	*Insufficient*	*Sufficient*	*Intoxication*	*Total*
Serum calcium	Low	11	23	12	1	47
	Normal	0	15	36	2	53
	Total					100
Serum phosphorus	Low	9	9	6	0	24
	Normal	2	26	39	3	70
	High	0	3	3	0	6
	Total					100

Insufficient levels of vitamin D were found to be maximum, i.e., 44.7%, in the menopausal group of 5 to 10 years and 31.6% in >10 years (Table 3).

Therefore, postmenopausal years of more than 5 years and vitamin D deficiency had significant corelation.

Among the studied population, 53% had normal levels of serum calcium and 47% were found to have inadequate levels (Table 4).

Among the studied population, 70% were found to have normal levels and only 24% were found to have inadequate levels of serum phosphorus (Table 5).

A total of 11 postmenopausal women had vitamin D deficiency accounting to 11%, 38 among the studied postmenopausal women were found to have insufficient levels, i.e., 38%, 48% had sufficient levels of vitamin D, and 3 patients had above normal values (Table 6).

Fisher's exact test p=0.000<0.001, highly significant (HS) for serum calcium.

Fisher's exact test p = 0.000<0.001, HS for serum phosphorus (Table 7).

Those with vitamin D level deficiency and insufficiency were also found to have deficient levels of serum calcium and phosphorus, making it significant (Table 7).

Among the studied population, 55% had adequate sun exposure and 45% did not have adequate sun exposure (Table 8).

Eight postmenopausal women with deficient levels were found to have inadequate sun exposure, 23 with insufficient levels of vitamin D had inadequate exposure

Table 8: Sun exposure among the studied population

Sun exposure	*Frequency*	*Percentage*
No	45	45
Yes	55	55
Total	100	100

Table 9: Vitamin D in relation to sun exposure

		Vitamin D				
Sun exposure		*Deficient*	*Insufficient*	*Sufficient*	*Intoxication*	*Total*
	Inadequate	8	23	14	0	45
	Adequate	3	15	34	3	55
	Total	11	38	48	3	100

Fisher's exact test p = 0.002, Highly significant

Table 10: Distribution of dietary intake among the studied population

		Frequency	*Percentage*
Dietary intake	Inadequate	61	61
	Adequate	39	39
	Total	100	100

Table 11: Vitamin D in relation to dietary intake

		Vitamin D			
		Deficient	*Insufficient*	*Sufficient*	*Total*
Dietary intake	Inadequate	11	32	18	61
	Adequate	0	6	30	39
	Total	11	38	48	100

Fisher's exact test p = 0.000 < 0.001, highly significant

Table 12: Distribution of diabetic patients among the studied population

		Frequency	*Percentage*
Diabetes	Nondiabetic	88	88
	Diabetic	12	12
	Total	100	100

to sun; 34 with sufficient levels had adequate sun exposure (Table 9).

Since the majority of the studied population with deficient and insufficient levels of vitamin D had inadequate sun exposure, there is a significant corelation between vitamin D deficiency and sun exposure (Table 9).

Dietary intake was found to be inadequate in 61% of the studied population, whereas 39% had adequate intake of calcium, vitamin D, and phosphorus through diet (Table 10).

Among the studied population, 11 with deficient levels of vitamin D and 32 with insufficient levels were found to have inadequate dietary intake; 30% with adequate dietary intake had sufficient levels of vitamin D among the studied population. Therefore, it signifies that adequate dietary intake is necessary for sufficient levels of vitamin D (Table 11).

Among the studied population, only 12% were found to be diabetic (Table 12).

Only 1 among the studied population with deficient vitamin D levels was diabetic, 5 were diabetic among the insufficient group, and 6 were diabetic among the sufficient group (Table 13). Therefore, no significant relation was found between vitamin D and those with diabetes.

In this study, we could not come to a definitive corelation between diabetes and vitamin D because levels of vitamin D were studied only among 100 patients included in the study and not specifically among the diabetics.

Thirteen patients among the studied population were found to be hypertensive and 87% had no hypertension (Table 14).

Among the studied population, only 5 patients with hypertension were found to have insufficient levels of vitamin D, 8 were hypertensive among the sufficient group, and none among the studied population with vitamin D deficiency were hypertensive, making it insignificant (Table 15).

Table 13: Vitamin D in relation to diabetes

		Vitamin D				
		Deficient	*Insufficient*	*Sufficient*	*Intoxication*	*Total*
Diabetes mellitus	Nondiabetic	10	33	42	3	88
	Diabetic	1	5	6	0	12
	Total	11	38	48	3	100

Fisher's exact test, p = 1.000, not significant

Table 14: Distribution of hypertensive patients among the studied population

		Frequency	*Percentage*
Hypertension	Not hypertensive	87	87
	Hypertensive	13	13
	Total	100	100

Table 15: Vitamin D in relation to hypertension

		Vitamin D				
		Deficient	*Insufficient*	*Sufficient*	*Intoxication*	*Total*
Hypertension	Not hypertensive	11	33	4o	3	87
	Hypertensive	0	5	8	0	13
	Total	11	38	48	3	100

Fisher's exact test p = 0.624, not significant

In this study, 100 patients were selected randomly based on the inclusion criteria and among them an insignificant population were found to be hypertensive to come to a definitive conclusion regarding the corelation between vitamin D and hypertension.

DISCUSSION

Vitamin D is a fat-soluble vitamin. It is carried in the bloodstream to the liver, where it is converted into the prohormone calcidiol. Calcidiol is then converted into calcitriol, the biologically active form of vitamin D, in the kidneys.[7]

Calcitriol also acts locally as a cytokine, stimulates the innate immune system,[8] and defends the body against microbial invaders.

Vitamin D_3 is produced photochemically from 7-dehydrocholesterol in the skin of humans.[9.] Moderate sun exposure to the face, arms, and legs, averaging 5 to 30 minutes twice per week, can produce adequate amounts of vitamin D. The other source of vitamin D is diet and it is found naturally in very few foods.

Main role of vitamin D is to maintain skeletal calcium balance by promoting calcium absorption in the intestines, promoting bone resorption by increasing osteoclast number, maintaining calcium and phosphate levels for bone formation, and allowing proper functioning of parathyroid hormone (PTH) to maintain serum calcium levels.[10]

Serum concentration of 25(OH)D is the best indicator of vitamin D status. It reflects vitamin D produced cutaneously and that obtained from food and supplements and has a fairly long circulating half-life of 15 days.[11]

In Harinarayan et al study with 164 postmenopausal women as the study population, a significant group of 52% had insufficient levels and 30% had deficient levels. Dietary intake of calcium was found to be inadequate. Similarly, in the present study, we found that 11% had vitamin D deficiency and 38% had insufficient levels and a significant corelation was found between vitamin D deficiency and inadequate dietary intake.

Harinarayan et al also studied levels of serum alkaline phosphatase and PTH levels, which were found to be high in those with vitamin D deficiency. These parameters were not taken into consideration in our study.

Chapuy et al in their study showed the effect of climatic variation and urbanization on vitamin D. They showed that in French normal adults living in an urban environment with a lack of direct exposure to sunshine, diet failed to provide an adequate amount of vitamin D, which was similar to our study where postmenopausal women with inadequate sun exposure were found to be vitamin D deficient.

In Sharma et al study, 53.35% of the population had vitamin D deficiency, 19.48% had insufficient levels, and 26.8% had adequate levels. Also, no significant relation was found between vitamin D and diabetes (p=0.324).

Similarly, in the present study, no corelation was found between diabetes and vitamin D.

Type II diabetes mellitus is found to be prevalent in individuals with vitamin D deficiency. This could be explained by insulin resistance and altered insulin secretion, associated with defects in pancreatic beta cell function.

Severe vitamin D deficiency predicts increased risk of cardiovascular mortality in type II diabetic patients.[12]

Vitamin D is deposited in body fat stores after which it is no longer bioavailable, explaining why a significant amount of obese individuals have vitamin D deficiency.

Pitas et al found that women with a daily total calcium and total vitamin D intake of more than 1,200 mg and 20 µg respectively, had a 33% lower risk of developing type II diabetes than those with a daily calcium and vitamin D intake of less than 600 mg and 10 µg respectively.[13]

In the present study, we found that 11% with vitamin D deficiency had inadequate dietary intake and 32% with insufficient levels of vitamin D had inadequate dietary intake. Serum calcium was found to be low in 47% and serum phosphorus was low in 24% and significant corelation was established with vitamin D, serum calcium, and serum phosphorus.

Schierbeck et al studied the relationship of vitamin D deficiency and adverse cardiovascular events,which was found to be significant. Vitamin D deficiency was defined as serum 25(OH)D 50 nmol/L. Women with vitamin D deficiency had lower hip–waist ratio and high-density lipoprotein and higher body mass index, triglycerides, PTH, and a trend toward higher fasting blood glucose. Dietary intake of calcium and vitamin D was found to be lower in the vitamin D-deficient group when compared with vitamin D–replete women.

Neuprez et al in their study got the mean age of patients as 76.9, whereas in our study most of the patients were in the age group of 51 to 60 years.

A high prevalence of vitamin D inadequacy in Belgian postmenopausal osteoporotic women was noted even among subjects receiving vitamin D supplement, in contrary to our study where patients taking calcium and vitamin D supplements were excluded. In this study, they did not reach any statistical significance ($p = 0.09$) for vitamin D concentrations.

In our present study, we got no significant relationship between hypertension and vitamin D deficiency. Shin et al in their study got a vitamin D deficiency [25(OH)D <15 ng/mL] as a significant risk factor for hypertension in postmenopausal women.

In the past, research on vitamin D was largely confined to diseases related to bone metabolism, such as osteoporosis or osteomalacia. However, interest in vitamin D is increasing due to recent research findings that vitamin D deficiency increases hypertension, high pulse pressure, obesity, hyperlipidemia, diabetes, etc., which increases the chance of cardiovascular disease.[14,15]

In the present study, we have correlated vitamin D deficiency with diabetes and hypertension, which are not significant and could be due to the small population considered.

Various other studies and a study by Hyon et al have shown that metabolic syndrome was associated with a decrease in serum 25(OH)D levels, which vary across countries and races, and previous studies targeted specific age groups and populations, such as adolescents, the aged, postmenopausal women, the obese, and diabetes.

Vitamin D is known to prevent cardiovascular disease, hypertension, diabetes, and osteoporosis,[16] and its deficiency is reported to lead to secondary hyperparathyroidism due to the increase in PTH levels in the blood, causing diabetes, elevated blood pressure, acceleration of atherosclerosis, cardiovascular calcification, etc.[17]

Vitamin D status decreases with age, mainly as a result of restricted sunlight exposure, reduced capacity of the skin to produce vitamin D, and reduced dietary vitamin D intake. R.P.J. van der Wielen in their study showed that regardless of geographical location, free-living elderly Europeans were at substantial risk of inadequate vitamin D status during winter.

Similarly, in our present study, we found a significant correlation with inadequate sun exposure and vitamin D deficiency though geographical location was not taken into consideration.[18]

In our study, the patients found with toxic levels of vitamin D were 3%, which could probably be due to technical errors or error in sample correction.

LIMITATION OF THE STUDY

The present study was just a community-based study and not a population-based study. The questionnaires used to assess dietary intake cannot be relied upon as an accurate method. A more accurate method would be to measure biomarkers for dietary intake, but biomarkers are not available for all factors and dietary assessments represent just a snapshot of vitamin intake at one point in time.

CONCLUSION

This study helped us to assess basal levels of vitamin D, serum calcium, and serum phosphorus among postmenopausal women, giving us an idea regarding prevalence of vitamin D deficiency in postmenopausal women among South Canara district.

In this study, we found that most of the patients had insufficient levels of vitamin D and only 11% had vitamin D deficiency, which could be due to the small sample size.

Serum calcium was found to be low in 47% and serum phosphorus was low in 24%. Significant corelation was established with vitamin D deficiency and calcium and phosphorus levels.

In this study, we found that most of the patients had insufficient levels of vitamin D, which could be due to the small sample size, and significant corelation was established between inadequate sun exposure and inadequate dietary intake with vitamin D deficiency. No significant correlation was found with hypertension, diabetes, and vitamin D deficiency.

We should consider counseling all postmenopausal patients regarding the benefit of vitamin D supplementation and benefits of adequate dietary intake and sun exposure.

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