Original Article

Vitamin D Status and Associated Factors among Peri Menopausal Women in Two Selected Districts of Kerala

Bindhu Vasudevan[1], Usha Karunakaran[2], Alwin Antony[3], Reshmi Ramachandran[3]

[1]Associate Professor, [3]Assistant Professor, Department of Community Medicine, Government Medical College, Ernakulam, Kerala, [2]Professor, Department of Community Medicine, Government Medical College, Pariyaram, India

Abstract

Background: Vitamin D deficiency is highly prevalent among the Indian population and it is found to be associated with many diseases among perimenopausal women in various hospital-based studies. **Objectives:** This study aimed to find out the Vitamin D status among perimenopausal women and to assess the association of selected factors with Vitamin D status among them. **Methods:** A cross-sectional study was conducted among 184 perimenopausal women in two districts of Kerala from July 2018 to February 2019. The data were collected and blood sample was taken for determining the 25(OH) D levels after obtaining informed written consent. Descriptive and inferential statistics were done using SPSS version 22. **Results:** Among the 184 women, 2 (1.1%) had sufficient, 18 (9.8%) had insufficient, and 164 (89.1%) had deficient 25(OH) D levels. The mean 25(OH) D levels among the population were 15.01 ± 4.32 ng/ml (95% confidence interval 14.38–15.63), much lower than the required level of 30 ng/ml. Vitamin D level was significantly higher among women who had exposure to sunlight, were on Vitamin D supplementation, and those who had skin diseases. 25(OH) D levels were higher among residents of Ernakulam district, older age group, low socioeconomic status, mixed-diet consumers, those who attained menopause, and those had calcium supplementation. The level was low among those who regularly use sunscreen topical applications and had other comorbidities such as hypothyroidism. However, none of these factors were significantly associated with 25(OH) D levels. **Conclusion:** The study showed that Vitamin D deficiency is highly prevalent among the study population.

Key words: 25(OH) D level, Kerala, perimenopausal women, Vitamin D status

Introduction

Vitamin D is an essential factor for normal metabolism of bone and bone minerals. It is also needed for several nonbone-related metabolic processes. Vitamin D deficiency can lead to skeletal abnormalities such as rickets, osteoporosis and osteopenia. It could also be associated with various extra-skeletal abnormalities such as cardiovascular diseases, diabetes, cancer, infections etc. Vitamin D deficiency is a pandemic, yet it is the most underdiagnosed and undertreated nutritional deficiency in the world.[1-3] In India, despite ample sunlight, it prevails in epidemic proportions all over the subcontinent and prevalence has been documented to be in the range of 50%–90% among all the age groups.[4] Indian socioreligious and cultural practices do not facilitate adequate sun exposure, thereby negating the potential benefits of plentiful sunshine. Consequently, subclinical Vitamin D deficiency is highly prevalent in both urban and rural settings, and across all socioeconomic and geographic strata. Owing to its multifarious implications on health, the epidemic of vitamin D deficiency in India is likely to contribute significantly to the enormous burden on the health system.

We are not sure how sex hormones affect Vitamin D conversion, but women seem to have a harder time stimulating the mechanism that builds bone tissue when their estrogen levels are reduced as in the case of peri- and postmenopausal women. Low dietary intake of calcium, indoor lifestyle, and

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Address for correspondence: Dr. Bindhu Vasudevan, Department of Community Medicine, Government Medical College, Ernakulam, Kerala, India.
E-mail: bindhuskr@gmail.com

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the clothing style of females in our culture and setting that may limit sun exposure cause a higher risk of low vitamin D and bone mineral status in our females, and go unnoticed for years. There are only a few published community studies regarding Vitamin D status from Kerala. Many of the studies on this topic are hospital based, looking for an association between Vitamin D status and various selected diseases. Studies regarding Vitamin D Status among the perimenopausal and postmenopausal women are also very limited from Kerala. Early diagnosis and management of Vitamin D deficiency can lead to the prevention of various future morbidities which may affect the quality of life of the women who undertake multidimensional roles in their daily life. Hence, the present study was conducted to find out the Vitamin D status and its association with selected factors among women aged between 40 and 60 years in two selected districts of Kerala.

Materials and Methods

Study design, setting, and subjects

It was a descriptive cross-sectional study conducted from July 2018 to February 2019 in the selected wards of Kalamassery municipality of Ernakulam district and Padanna panchayath of Kasargod district in Kerala. Study participants were perimenopausal women of age group 40–60 years residing in the selected wards. Pregnant and lactating women, those who have bleeding disorders, and those who were not willing to participate in the study were excluded.

Sample size and selection of subjects

According to a study conducted by Harinarayan and Joshi at Thirupathi, the prevalence of Vitamin D deficiency among postmenopausal women was 70%.[4] Based on this information and using the formula $(z\alpha)^2 p(1 - p)/d^2$, with a 95% level of confidence, and relative precision of 10%, the minimum sample size for the present study was calculated to be 171, approximated to 180.

Two districts of Kerala, Ernakulam and Kasargod, were selected conveniently for the study purpose. One ward each from Kalamassery municipality of Ernakulam district and Padanna Panchayath of Kasargod district were selected randomly for the study. Eligible study subjects were recruited on a camp basis, after giving sufficient publicity in the area. Ninety eligible study subjects who registered first in the camp were included in the study from each area.

Data collection procedure

Data were collected on a camp basis. Medical officers of the concerned primary health centers of the wards and junior public health nurses, junior health inspectors, and accredited social health activist workers of the selected ward were sensitized about the study. All persons attending the camp were ensured basic medical care including the service of an orthopedician, irrespective of their participation in the study.

After obtaining written informed consent from each study subject, they were interviewed using a pretested questionnaire. The questionnaire was used to collect information regarding basic sociodemographic variables, dietary habits, comorbidity status, exposure to sunlight, usage of sunscreen topical applications, purdha, Vitamin D and calcium supplementation, etc.

For all study subjects, peripheral venous blood samples were collected, by a qualified lab technician using a 5cc automated syringe with a needle, for measuring 25(OH) D levels. Blood collected from the camp was transported to a single accredited laboratory in cool packs until they were separated and stored for further analysis. The blood samples were centrifuged for 10 min at 2500 rmp to separate the serum. 25(OH) D levels were assessed using chemiluminescence immunoassay, which is a one-pass immunoassay, designed with a competitive format architecture that uses a proprietary anti-fluorescein labeled Fluorescein isothiocyanate (FITC) monoclonal antibody covalently bound to paramagnetic particles, one monoclonal antibody labeled with acridinium ester, and a Vitamin D analog labeled with fluorescein. The assay is standardized using internal standards which are traceable by method correlation to Ghent University's ID-LC/MS/MS 25(OH) vitamin D RMP. Biomedical waste generated during the camps was disposed according to the standard guidelines. Vitamin D status of each study subject was communicated to them at the earliest and was referred for further treatment if needed.

Ethical considerations

Permission from the Scientific Review Committee was obtained from Government Medical College, Ernakulam. Ethical clearance was obtained from IRB of Government Medical College, Ernakulam, and Medical College, Pariyaram. Informed written consent was obtained from each study subject.

Data management and analysis

Data were coded and entered into Microsoft Excel. Analysis was done using SPSS Version 22 (IBM. Corp. Armonk, NY) Qualitative data were summarized using frequency and percentage. Quantitative data were summarized using mean and SD 25(OH) D levels were interpreted as follows – Vitamin D sufficiency: >30 ng/ml; Vitamin D insufficiency: 20–30 ng/ml; and Vitamin D deficiency: <20 ng/ml. Association between Vitamin D status and selected factors was done using Chi-square test and Fisher's exact test, whereas the association between mean 25(OH) D level and the associated factors was done by independent sample *t*-test and ANOVA test. The significance level was fixed at $P \leq 0.05$.

Results

A total of 184 females of 40–60 years of age residing in Ernakulam and Kasargod districts of Kerala were studied to assess the Vitamin D status. The mean age of the study population was 48.62 ± 6.3 years. Among the study population, 167 (90.8%) were Hindus, 12 (6.5%) were Christians, and 5 (2.7%) were Muslims. There were 94 (51.9%) people who

resided in Ernakulam district and 90 (48.9%) women who resided in Kasargod district of Kerala. The mean 25(OH) D level of the study population was 15.01 ng/ml ± 4.32 (95% confidence interval: 14.38–15.64). Among the study population, 164 (89.1%) had Vitamin D deficiency with a mean 25(OH) D level of 13.95 ng/ml ± 2.9 (95% confidence interval [CI]–13.49–14.39). Only two women had sufficient Vitamin D levels with a mean 25(OH) D level of 32.46 ng/ml ± 3.46 (95% CI: 30.01–34.91). Among the 18 (9.8%) women who had Vitamin D insufficiency, the mean 25(OH) D level was 22.71 ng/ml ± 2.58 (95% CI: 21.42–23.99). The study population was divided into Vitamin D-deficient and not deficient groups for further analysis.

Table 1 depicts the association of Vitamin D deficiency status and various sociodemographic variables. Vitamin D deficiency was more among the people residing in Ernakulam district as compared to Kasargod district. However, the two women who had sufficient Vitamin D levels were also residents of Ernakulam district. According to the present study, deficiency was more among younger age group, Hindu religion, and middle and upper socioeconomic status. None of the sociodemographic variables were significantly associated with Vitamin D status.

Among the study population, 84 women attained menopause. Among these 84 women, 72 (85.7%) had Vitamin D deficiency as compared to 92 out of 100 women who had not attained menopause, but the difference was not statistically significant. Similarly among the menstruating women, there was no statistically significant difference in Vitamin D deficiency status between the women who had regular and irregular menstrual cycles (95% vs. 91.3%, $P = 0.42$).

The present study revealed that Vitamin D deficiency was highly prevalent among people with various noncommunicable diseases such as hypertension and diabetes mellitus. Among 37 women who had hypertension, 21 (56.7%) had Vitamin D deficiency. It was also noted that, in the present study, 85% women who had Diabetes and 96.3% women who had Thyroid abnormalities, had accompanying Vitamin D deficiency. However, the study could not reveal any significant association between noncommunicable disease conditions and Vitamin D status.

Vitamin D deficiency was found to be more among the vegetarians (92.3% vs. 88.9%) and among those who don't consume fish (91.8% vs. 87.8%) and egg (89.2% vs. 88.9%) regularly. Paradoxically, Vitamin D deficiency was seen more among the people who consumed milk regularly (92.1% vs. 86.3%). However, the two people with sufficient Vitamin D level reported regular consumption of milk. The study could not reveal any significant association between Vitamin D status and dietary factors.

The study showed that Vitamin D deficiency was less among women who were exposed to sunlight for more than 45 min (87.9% vs. 90.3%, Chi-square test, $P = 0.86$). All seven women who used sunscreen regularly had Vitamin D deficiency. However, the association was not statistically significant. The study also could not reveal a significant association between the time of the day during which they were exposed to sunlight and Vitamin D status. Two out of 3 (66.7%) women who used purdha were found to have Vitamin D deficiency and 15 out of 16 (93.8%) women who used dress that covers their extremities had Vitamin D deficiency. Only three women were taking Vitamin D supplementation for 1 month and none of them had Vitamin D deficiency, whereas among the five women who had regular calcium supplementation, four had Vitamin D deficiency. None of these factors were significantly associated with the Vitamin D status of the study subjects except the regular vitamin D supplementation.

Table 2 shows the association of mean 25(OH) D level and various sociodemographic factors. The mean 25(OH) D level was higher among the people residing in Ernakulam district, older

Table 1: Association of vitamin D status and selected sociodemographic factors

Variables	Vitamin D status		Statistical significance
	Deficiency, *n* (%)	No deficiency, *n* (%)	
Districts			
Ernakulam (*n*=94)	85 (90.4)	9 (9.6)	χ^2=0.33, *P*=0.56
Kasargod (*n*=90)	79 (87.8)	11 (12.2)	
Age group (years)			
40-50 (*n*=117)	107 (91.5)	10 (8.5)	χ^2=1.78, *P*=0.18
50-60 (*n*=67)	57 (85.1)	10 (14.9)	
Religion			
Hindu (*n*=167)	151 (90.4)	16 (9.6)	Fisher's exact test: 6.32, *P*=0.22
Christian (*n*=12)	9 (75)	3 (25)	
Muslim (*n*=5)	4 (80)	1 (20)	
Socioeconomic status			
High (*n*=3)	3 (100)	0	Fisher's exact test: 5.74, *P*=0.39
Middle (*n*=35)	33 (94.2)	2 (5.8)	
Low (*n*=139)	121 (87.1)	18 (12.9)	

age group, Christians, and low socioeconomic status. However, the study could not reveal a significant association with mean 25(OH) D level and various sociodemographic variables.

Table 3 depicts the association of 25(OH) D levels with selected risk factors. The mean 25(OH) D level was higher among postmenopausal women. It was also higher among the menstruating women who had regular cycles compared to irregular cycles (15.38 ± 4.4 vs. 13.3 ± 3.2). Attainment of menopause or presence of regular cycle was not significantly associated with 25(OH) D levels among the study population. Among the eight women who had some kind of skin diseases, the 25(OH) D level was significantly higher compared to the women who did not have any skin diseases. Women consuming a mixed diet seem to have a higher 25(OH) D level. It was also higher among ladies who consume fish (15.16 ± 4.31 vs. 14.68 ± 0.42) and egg (15.07 ± 4.33 vs. 14.38 ± 3.88) regularly. Paradoxically, it was low among those who consume milk (14.75 ± 4.78 ± vs. 15.24 ± 4.31) and meat (11.54 ± 2.04 vs. 15.08 ± 4.29) regularly. However, none of the dietary parameters were significantly associated with 25(OH) D levels.

Regular exposure to sunlight especially in the morning hours was significantly associated with a higher 25(OH) D level. Similarly, regular use of sunscreen lotion seems to reduce the 25(OH) D level in the study population. Usage of purdha and dress covering most of the body parts of the study subjects were not found to have affected the level of 25(OH) D in the body. Another factor which was significantly associated with a higher 25(OH) D level was the Vitamin D supplementation. Calcium supplementation also seemed to increase the 25(OH) D level, but the association was not statistically significant.

Table 2: Association of 25(OH) D level and sociodemographic variables

Variables	25(OH) D level (ng/ml), mean±SD	Statistical significance
Districts		
Ernakulam (*n*=94)	15.2±4.51	*t*=−0.63, *P*=0.52
Kasargod (*n*=90)	14.79±4.01	
Age group 9 (years)		
40-50 (*n*=117)	14.86±4.62	*t*=−0.6, *P*=0.54
50-60 (*n*=67)	15.26±3.66	
Religion		
Hindu (*n*=167)	14.9±4.1	ANOVA *F*=0.6, *P*=0.55
Christian (*n*=12)	16.3±6.01	
Muslim (*n*=5)	14.83±4.4	
Socio economic status		
Low (*n*=139)	15.27±4.05	ANOVA *F*=−1.29, *P*=0.277
Middle (*n*=35)	14.36±5.35	
High (*n*=3)	12.1±5.1	

SD: Standard deviation

Discussion

The present study revealed that Vitamin D deficiency is highly

Table 3: Association of 25(OH) D level and selected risk factors

Variables	Vitamin D level (ng/ml), mean±SD	Statistical significance
Menopause attained		
Yes (*n*=84)	15.19±4.06	*t*=0.55, *P*=0.58
No (*n*=100)	14.84±4.5	
Skin diseases		
Yes (*n*=8)	18.42±7.1	*t*=−0.18, *P*=0.02*
No (*n*=176)	14.84±4.1	
Thyroid disorders		
Yes (*n*=27)	14.75±3.9	*t*=−0.52, *P*=0.74
No (*n*=157)	15.04±4.36	
Pattern of diet		
Vegetarian (*n*=13)	13.39±3.8	*t*=−0.77, *P*=0.43
Mixed diet (*n*=171)	15.13±4.3	
Exposure to sunlight>45 min		
Yes (*n*=91)	15.9±3.62	*t*=−2.89, *P*=0.004*
No (*n*=93)	14.11±4.7	
Use of sunscreen		
Yes (*n*=7)	14.23±2.42	*t*=−0.48 *P*=0.62
No (*n*=177)	15.03±4.35	
Use of Vitamin D supplementation		
Yes (*n*=3)	28.35±1.43	*t*=3.18, *P*=0.02*
No (*n*=181)	14.92±2.34	
Use of calcium supplementation		
Yes (*n*=5)	17.55±6.38	*t*=1.35, *P*=0.179
No (*n*=179)	14.93±4.2	

**P*=0.02, SD: Standard deviation

prevalent among the study subjects. The mean 25(OH) D level of the study population was only 15.01 ± 4.32 (95% CI 14.38–15.64) which is much lower than the recommended value. This finding is similar to many studies conducted among females in India by different investigators such as C. V Harinarayan and Joshi in Tirupathi, Goswami *et al*. near Delhi, Sachan *et al*. in Lucknow, and Beloyartseva *et al*. in 18 cities spread all over India.[4-7] The study conducted by Zargar *et al*. in Kashmir, Marwaha *et al*. in Delhi, and Kadam *et al*. in Pune showed a lower mean serum 25(OH) D values among the women.[8-10] A higher mean value of serum 25(OH) D was reported among the women of Punjab and Haryana by Tandon *et al*.[11] A study conducted in Kandy, Sri Lanka, revealed that the mean serum 25(OH) D value among adult females was found to be 18.96 ± 6.32.[12]

According to the present study, only 1.1% of women had sufficient Vitamin D levels. Vitamin D deficiency with a 25(OH) D value of <20 ng/ml was found in 164 (89.1%) women. These findings were similar to that of studies by Multani *et al*. and Harinarayan *et al*.[13,14] These findings call for large population-based studies to reassess the normal value/cutoff values of serum 25(OH) D levels among the Indian population. The cutoffs for defining Vitamin D deficiency and sufficiency are being debated by authors like Hollis and Wagner.[15] Amy E Millen in his article recommended that investigators may recommend multiple cutoffs for serum 25(OH) D levels with respect to disease diagnosis.[16]

The study could not reveal any statistically significant difference in the Vitamin D status between women residing in Kalamassery municipality of Ernakulam district, which is an urban area, and women residing in Padanna panchayath of Kasargod district which is more of a rural area. The mean serum 25(OH) D value of urban women was also higher when compared to rural women. Most of the studies conducted in different parts of the country revealed a higher mean serum 25(OH) D value among rural adults.[6,8,17,18] The reason for the rural–urban difference could be due to the dressing pattern of women residing here. This difference is minimal in Kerala owing to the rural–urban continuum which is a unique pattern of Kerala society. Hence, there is no such difference in the dressing pattern of people residing in these two settings in Kerala. Being a small state, there may not be much difference in the latitude and longitude of different places in Kerala, and hence, there may not be much difference in the availability of sunshine as well.

The present study revealed that the mean serum 25(OH) D value was higher among the older age group and lower socioeconomic status, but the difference was not statistically significant. It could be due to the fact that many of the postmenopausal women are being prescribed calcium and vitamin D when they consult a doctor for various bone-related ailments. These findings were similar to that of the studies done by Marwaha *et al*., Kadam *et al*., and Harinarayan *et al*. and Islam *et al*.[9,10,14,19] Puri *et al*. had observed a higher mean value of serum 25(OH) D among the schoolgirls of lower income group in Delhi compared to the girls belonging to high-income group.[20] According to Marwaha *et al*. and Islam *et al*. in Dhaka, the mean serum 25(OH) D values were high among higher socioeconomic status[9,19] which is contradictory to the present study.

This study revealed that mean serum 25(OH) D level was significantly higher among the women who were exposed to sunlight for ≥45 min; women who had some skin disease, and those who were taking Vitamin D supplementation. The present study also found that mean serum 25(OH) D level was higher among postmenopausal women and among women on calcium supplements, though this was not found to be statistically significant. The mean serum 25(OH) D level was also lower among the vegetarians, those who use sunscreen regularly, and among those who had thyroid disorders, but these associations were also not found to be statistically significant. A study conducted by Brustad *et al*. reported that serum 25(OH) D values were directly related to UV hours per day.[21] Some studies have presented significant correlations between serum 25(OH) D and self-reported sun exposure.[22-24]

Some investigators have reported a positive association between oral supplementation of Vitamin D and serum 25(OH) D level.[23,25,26] However, Marwaha *et al*. could not find any association with calcium or Vitamin D supplementation and serum 25(OH) D level in their study among adult healthy Indians.[9] Malhotra *et al*. and Goswami *et al*. recommended that a daily supplementation of 60,000–1, 20,000 IU Vitamin D is required to achieve a mean serum 25(OH) D level >30 ng/ml.[27,28] A study conducted by McCullough *et al*. revealed that there is a decrease in the level of serum 25(OH) D after giving calcium supplementation for 6 months.[29]

The study conducted by Heimbeck *et al*. among children showed a higher mean serum 25(OH) D among German children who had eczema, which is similar to our study finding.[30]

Vitamin D deficiency among perimenopausal women continues to be a hidden public health menace, this might have a long-standing consequence. Owing to its multifarious implications on health, ignoring the same could adversely affect the quality of life of females in this age group. Hence, large population-based studies to assess the true burden of this hidden pandemic are the need of the hour.

Conclusion

The present study concluded that Vitamin D Deficiency is highly prevalent among the perimenopausal women of central and North Kerala. Population-based studies among various subsets of the population to ascertain the normal cutoff value of serum 25(OH) D are recommended.

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Conflicts of interest

There are no conflicts of interest.

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