

ORIGINAL ARTICLE

Vitamin D and Calcium Levels among Women of Reproductive Age Group from Northern India

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| Abstract | Introduction | Methodology | Results | Conclusion | References | Citation | Tables / Figures |
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Abstract

Background: Vitamin D deficiency has been related to poor bone health, increased risk of PIH, obstructed labour, vaginosis and LBW baby among women of reproductive age. **Aims & Objectives:** To evaluate the serum calcium and vitamin D levels of reproductive age group women and their relation with sociodemographic parameters. **Material & Methods:** A cross-sectional study was conducted among non-pregnant and non-lactating women aged 15-49 years, attending the OPD for any musculoskeletal complaints. The study participants were subjected to a pretested questionnaire for capturing information regarding their sociodemographic parameters. Non fasting blood samples were obtained for biochemical analysis of serum vitamin D and calcium. **Results:** The mean serum vitamin D and calcium levels were 20.94±10.61 ng/ml and 4.82±0.87 mg/dl respectively. The median serum vitamin D levels were 18.1 ng/ml with IQR of 12.43-28.00 ng/ml. The median serum vitamin D levels were significantly less among women residing in rural area and those who were unmarried/separated. Vitamin D level were highest in middle and lowest in upper socioeconomic status (p=0.007). **Conclusion:** Vitamin D deficiency is more pronounced among women from rural background and those who were unmarried/separated. These women are susceptible to development of osteoporosis and pregnancy related complications in later age.

Keywords

Vitamin D; Socioeconomic Class; Calcium; Prevalence; Reproductive Age Women

Introduction

Vitamin D, a fat-soluble hormone gained through exposure to sunlight and/or diet, has been recognized as a forerunner that regulates long-term programming of human health. (1) Vitamin D deficiency is now recognized as a pandemic, with prevalence in between 70–100 percent in the general population, whereas, among Indian population with low dietary calcium intake, a prevalence of varying degrees (50–90%) has been reported. (2-4) Maternal vitamin D deficiency has been linked with poor bone density, increased susceptibility to osteoporosis especially in women who have multiple episodes of pregnancy and lactation. (5) Harinarayan *et al.*, found that

among reproductive age group women of south-India, the prevalence of vitamin D deficiency was 55%. (6) Sofi *et al.*, found that among reproductive age group women of North India, the prevalence of vitamin D deficiency was 88%. (5) It is suggested that vitamin D-deficient women were at high risk for fatal reproductive outcomes. (7) Sufficient vitamin D levels during pregnancy help ensure appropriate maternal and fetal calcium homeostasis and bone. (8) This study was planned with the aim of measuring the serum calcium and serum vitamin D levels of females in reproductive age group so that timely action can be taken to prevent related complications.

Aims & Objectives

To evaluate serum calcium and vitamin D levels of reproductive age group women.

Material & Methods

Study Design: Cross-sectional study on reproductive women aged between 15-49 years

Study Setting and Participants: The study was conducted in Outpatient (OPD) of Department of Physical Medicine and Rehabilitation (PM&R) of Lucknow, North India. Females aged 15-49 years, attending the OPD of PM&R department, were enrolled in the study after informed verbal and written consent.

Study Period: 2020-2023. After obtaining the ethical clearance from Institutional Ethical Committee (65/Ethics/2020) on date 11/02/2020, the patient enrolment and data collection began from March 2020.

Inclusion criteria

1. Reproductive age group women between 15-49 years
2. Women who consented to participate and cooperate in the study
3. Preservation of internal genital organs

Exclusion criteria

1. Pregnant and lactating women between age group of 15-49 years
2. Patients with a history of chronic diseases, diabetes mellitus Type 1, hypertension, thyroid and parathyroid diseases, malabsorption syndrome, osteomalacia, osteoporosis, kidney disease, liver disease, breast feeding
3. Patients who had used vitamin D supplement in the previous month.

Sample size: Finite Population Correction has been applied to the sample size formula⁽²⁾ $n = N * X / (X + N - 1)$, where $X = Z_{\alpha/2}^2 * p * (1-p) / d^2$. **Z $\alpha/2$** -critical value of the normal distribution at $\alpha/2$ (for a confidence level of 95%, $\alpha=0.05$ and the **critical value is 1.96**), **Z β** -critical value of the normal distribution at β (for power of 80%, $\beta=0.2$ and the **critical value equals to 0.84**), **P** - Estimated sample proportion of non-pregnant and non-lactating reproductive age group women with vitamin D deficiency (**value is 88% from Sofi NY et al (2018)(5)**), **d** - Margin of error for appropriate level of precision (**value is 0.05**) **N** - Estimated population size i.e. approximate frequency of non-pregnant and non-lactating reproductive age group women attending outpatient department (**value is 250**). At 95% confidence interval and power of 80%, the **minimum sample size (n)** required was **99**. Taking 10 percent non-response rate; the final sample size was **110 reproductive age group women**.

Sampling technique: Systematic random sampling was used. Every second non-pregnant and non-lactating reproductive age group women was enrolled in the study after consent. If women refused to participate in the study, then next women were enrolled.

Data collection: All non-pregnant and non-lactating reproductive age group women attending the OPD for any bone related complaint, who fulfilled the inclusion criteria, were enrolled in the study after informed written consent. The procedures followed in the study were in accordance with the ethical standards of the institutional committee on human experimentation and with the Helsinki Declaration of 1975 that was revised in 2013.

- Each study participant was subjected to a pretested structured questionnaire to obtain information on sociodemographic profile such as name, age, educational qualification, present occupation, and monthly income of the family. The socioeconomic status of the individuals was calculated using Modified B.G.Prasad classification.
- Non-fasting blood samples were collected from all the study individuals for serum 25(OH) D and total calcium (Ca) level estimation. Serum 25(OH) D (25 hydroxyvit D) and total calcium levels was estimated by chemiluminescent immunoassay and colorimetric assay technique. The values were documented in ng/ml and mg/dl.
- As per latest recommendation of International Endocrine Society on serum vitamin D level, subjects were divided into three groups, (1) 25(OH) vit D < 20 ng/ml were diagnosed as vitamin D deficiency (VDD), (2) 25(OH) vit D level = 20–40 ng/mL were considered as vitamin D insufficient (VDI) and 25(OH) vit D > 40 ng/mL were considered as vitamin D sufficient (VDS). (9)
- Deficiency of calcium was defined as serum total calcium < 9.0 mg/dl. (10)

Data analysis: Data was analysed using SPSS version 23.0. Descriptive statistics including mean, standard deviation (SD), frequencies expressed as percentages was used to present information regarding calcium and vitamin D levels. Vitamin D deficiency was assessed as a categorical variable i.e., mild, moderate, and severe. Since data was right-sided skewed so median was the measure of central tendency. Mann Whitney and Kruskal Wallis test was used to see association of vitamin D levels with sociodemographic parameters. Probability (p) was calculated to test statistical significance at the 5% level of significance.

Results

The mean serum vitamin D levels and calcium levels were 20.94±10.61 ng/ml and 4.82±0.87 mg/dl respectively. The median serum vitamin D levels were 18.1 ng/ml with IQR of 12.43-28.00 ng/ml. Since the mean > median > mode, so the data was positively skewed (0.952) and median was the measure of central tendency indicating that vitamin D levels were scattered in our study sample.

The median serum vitamin D levels were significantly higher among women residing in urban (20.1 ng/ml) area as compared to those from rural area (16.7 ng/ml). The

median vitamin levels were 18.7, 15.29, 6.2 and 20.73 ng/ml among married, unmarried, separated and widowed women respectively. The vitamin D levels were higher among widowed women and was lowest among the separated and this was statistically significant ($p=0.009$). On the basis of educational status, maximum vitamin D levels were observed among those with diploma and above education (32.0 ng/ml) and minimum levels were seen among those women who had received education upto high school (15.35 ng/ml) and this was statistically significant. The median vitamin D levels among individuals from Lower, Lower middle, middle, upper middle and upper socioeconomic status was 18.1, 18.05, 32.0, 17.9 and 16.78 ng/ml respectively. It was found that women from the middle socioeconomic status had the highest vitamin D level while lowest values were seen for those belonging to upper socioeconomic status and this was highly significant ($p=0.007$).

The graph (Figure 1) depicts that vitamin D levels were scattered in the study population as the curve was positively skewed (0.952). Hence median was the measure of central tendency. The pie chart (Figure 2) clearly indicates that more than half (59.09%) of the study participants had deficient vitamin D levels. One third (33.63%) of the study participants had insufficient vitamin D levels. Only 7.2 percent study participants had adequate vitamin D levels.

Discussion

The prevalence of Vitamin D deficiency is reported worldwide, both in sunlight deficient and sunshine sufficient countries. Still, it is the most under-diagnosed and undertreated nutritional deficiency in the world. (11,12) India is a country with ample sunshine but still, vitamin D deficiency continues to be a growing public health concern. Besides, geographic factors and ambient UVB radiation, there are a varied number of individual-specific factors that influence the endogenous production of vitamin D, such as restricted access to sunlight, air pollution, any skin pathology, time spent outdoors, type of clothing, and sun protection practices. (5)

The mean and median levels of serum vitamin D levels in this study are similar to that reported by Shukla K et al. (13) The present study has documented that 59.09 percent of the study participants had deficient vitamin D levels i.e. <20 and 33.63 percent had insufficient levels (20-40) which is slight lower to that reported by Sofi et al in her study among reproductive age group women from Delhi where prevalence was 88 percent. (5) This can be accredited to the fact that non-random participant selection was adopted by the researchers which might have caused slight over-estimation of the deficiency. The earlier studies conducted in India have also documented similar results of (96%), (76%), (58.5%), and (83%) among women of reproductive age clearly demonstrating that more than half of this vulnerable group suffers from

vitamin D deficiency. (6,14-16) Hospital-based studies from India generally show a prevalence of Vitamin D deficiency ranging from 37% to 99%. (17)

The serum vitamin D levels in our study were less in the women from rural areas as compared to those from urban. This is in agreement to the findings of Sahu M et al who provided the first Indian rural community prevalence data on vitamin D deficiency in adolescent girls and pregnant women from northern India. They have described that the cause for deficiency of vitamin D among rural women of northern India in spite of good sun shine exposure is due to poor dietary intake of calcium. (18) Few researchers have also reported that the dietary phytates were comparable in both the rural and urban groups in Indian population, but the dietary phytate/calcium ratio was remarkably elevated among rural subjects. Phytate rich diet is known to reduce the intestinal absorption of calcium. Hence, low dietary calcium increases the catabolism of 25(OH) D and increases the inactive metabolites with the resultant reduction in 25(OH)D concentrations. (17) Moreover, the dietary intake in the urban group was high in calories, milk, milk products and vegetables due to which they have normal levels. (6,19) The present study has documented lower vitamin D levels among separated women followed by unmarried women. Although there is lack of scientific evidence from India associating marital status with vitamin D levels, still this finding is consistent with that by Khalfa HM et al who have explained that single females (separated/unmarried) are more susceptible to deficient vitamin D3 levels due to their lacking sexual activity and inter hormonal play. (20)

Our study depicts that women with highest level of education i.e. diploma and above had maximum serum vitamin D levels and this is similar to study by Ruchika et al where majority of the literate women had adequate levels and this is because higher the level of education, greater is the level of awareness for health and nutrition and better dietary intake. (21) Lastly this study shows that women belonging to lower, lower middle and middle socioeconomic status had maximum vitamin D levels and this is in concordance with study by Sofi et al who found similar pattern among the reproductive age group women from Delhi. The reason for this pattern is that women from lower, lower middle and middle socioeconomic status in India have high sun exposure and active lifestyle (5) Holick et al. Has documented that the time to maximum previtamin D formation is 0.75–1.5 h in darker (type V) skin, in contrast to 0.25–0.5 h in fairer (type III A) skin, during exposure to equatorial amounts of UV energy. As previtamin D is formed in the skin, isomerization to inactive products also takes place simultaneously, resulting in removal of vitamin D during prolonged sun exposure. (2)

The study has generated useful evidence regarding the prevalence and status of vitamin D levels among reproductive age group women from northern India.

Conclusion & Recommendation

There is prevalence of vitamin D deficiency across all socioeconomic groups in women of reproductive age of Indian origin. This deficiency is more pronounced among women from rural background and those who were unmarried/separated. These women are highly susceptible to develop osteoporosis and pregnancy related complications in later age.

Due to paucity of naturally occurring vitamin D rich foods in our country, food fortification with Vitamin D should be an important intervention among these women. Awareness should be raised among this vulnerable group regarding adequate sun exposure, healthy lifestyle and diet. There should be inclusion of vitamin D supplementation in the national nutrition programmes. More community-based studies on a larger sample size and with higher level of evidence should be conducted among in women of reproductive age group so as to ascertain our findings.

Limitation of the study

Firstly, the small sample size and hospital-based nature of the study limits its generalizability. Secondly, no information regarding dietary vitamin D intake, UVB exposure, sunscreen use, or measures of adiposity were obtained from the study participants which influences the vitamin D levels in an individual.

Relevance of the study

Classically it is thought that Vitamin D deficiency will be more in urban and higher socioeconomic class but this study showed, Vitamin D deficiency is more prevalent among middle and rural socioeconomic class.

Authors Contribution

All authors have contributed equally.

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Tables

TABLE 1: DESCRIPTIVE STATISTICS OF SERUM VITAMIN D AND CALCIUM LEVELS (N=110)

| Descriptive Statistics | Serum Vitamin D Levels (ng/ml) | Serum Calcium Levels (mg/dl) |
|------------------------|--------------------------------|------------------------------|
| Mean ± S.D. | 20.94±10.61 | 4.82±0.87 |
| Median | 18.10 | 4.71 |
| Mode | 17.90 | 5.00 |
| Minimum | 47.40 | 5.60 |
| Maximum | 4.00 | 3.60 |
| Range | 51.40 | 9.20 |
| Skewness | 0.952 | 3.434 |
| Quartiles 25 | 12.43 | 4.41 |
| 50 | 18.10 | 4.71 |
| 75 | 28.00 | 5.10 |

TABLE 2: STATUS OF SERUM VITAMIN D LEVELS IN THE STUDY PARTICIPANTS (N=110)

| Parameter | Media n | IQR* | Minim um | Maxim um | p Value | |
|-----------------|-----------|-------|----------|----------|---------|---------|
| Age (years) | 15-30 | 17.9 | 16.90 | 9.00 | 51.40 | 0.542 |
| | 31-49 | 18.1 | 7.50 | 5.8 | 46.0 | † |
| Religion | Hindu | 18.7 | 16.08 | 4.0 | 46.0 | 0.822 |
| | Muslim | 17.98 | 10.35 | 5.8 | 51.4 | † |
| Background | Rural | 16.7 | 7.2 | 4.0 | 46.0 | 0.001 |
| | Urban | 20.1 | 15.38 | 7.1 | 51.4 | † |
| Marital Status* | Married | 18.7 | 16.98 | 5.8 | 51.4 | 0.009 ‡ |
| | Unmarried | 15.29 | 16.20 | 4.0 | 29.8 | |
| | Separated | 6.2 | 0.0 | 6.2 | 10.36 | |
| | Widowed | 20.73 | 1.14 | 20.16 | 21.30 | |

| Parameter | Media n | IQR* | Minim um | Maxim um | p Value | |
|-----------------------|-------------------|-------|----------|----------|---------|---------|
| Education | Illiterate | 18.1 | 4.1 | 10.3 | 36.0 | 0.049 ‡ |
| | Primary School | 18.43 | 12.8 | 5.8 | 42.0 | |
| | Middle School | 17.90 | 10.24 | 4.0 | 29.8 | |
| | High School | 15.35 | 8.3 | 9.0 | 46.0 | |
| | Intermediate | 16.40 | 23.83 | 11.92 | 40.05 | |
| | Diploma and above | 32.0 | 21.08 | 7.10 | 51.4 | |
| Occupation | Homemaker | 18.08 | 12.45 | 5.8 | 51.4 | 0.294 † |
| | Others | 21.90 | 14.58 | 4.0 | 35.9 | |
| Socioeconomic Status§ | Upper | 18.1 | 8.2 | 5.8 | 37.23 | 0.007 ‡ |
| | Upper Middle | 18.05 | 13.42 | 4.0 | 40.05 | |
| | Middle | 32.0 | 24.7 | 10.36 | 51.40 | |
| | Lower Middle | 17.90 | 14.13 | 10.11 | 32.00 | |
| | Lower | 16.78 | 21.0 | 6.20 | 27.20 | |
| Body Mass Index | Underweight | 31.78 | 0.0 | 10.36 | 31.78 | 0.621 ‡ |
| | Normal | 18.45 | 14.13 | 4.0 | 51.4 | |
| | Overweight | 17.90 | 12.6 | 8.2 | 46.0 | |

§Modified B.G.Prasad Classification, *IQR: Interquartile range, †Mann Whitney U Test, ‡Krusal Wallis Test

Figures

FIGURE 1: FREQUENCY DISTRIBUTION OF SERUM VITAMIN D LEVELS IN STUDY POPULATION.

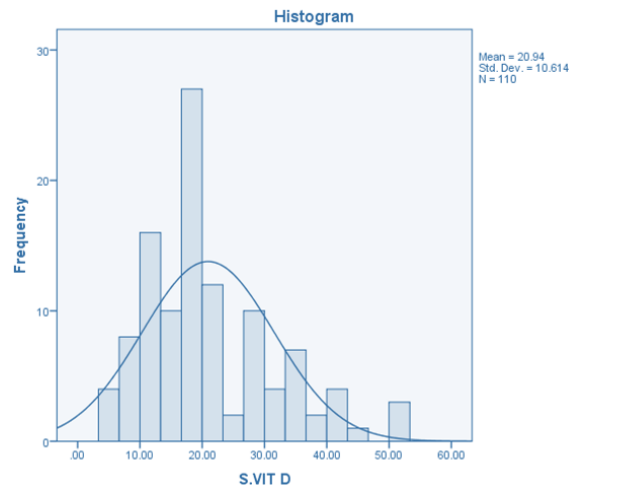


FIGURE 2: STATUS OF SERUM VITAMIN D LEVELS IN THE STUDY POPULATION

