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Socioeconomic Determinants of Vitamin D Status in Women

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Abstract

Background: Vitamin D deficiency can adversely affect women's health and their offspring. Studies have uncovered many determinants of vitamin D; however, few have explored its relationship with socioeconomic status.
Objectives: We aimed to determine the serum 25(OH)D level and its relationship with socioeconomic status.
Methods: We recruited 182 women between the ages of 18 years to 65 years from eastern Nepal from a previous study. Sociodemographic variables were obtained from a semi-structured questionnaire and used to construct separate and aggregate indicators of socioeconomic status. The association of these indicators with vitamin D status was examined. We used serum 25(OH)D levels as a measure of vitamin D status and classified them as deficient (< 20 ng/mL), insufficient (20 - 29 ng/mL), and sufficient (30 - 100 ng/mL).
Results: Median serum 25(OH)D was 18.6 ng/mL (25th - 75th percentile 14.3 - 23.9). Out of the total participants, 103 (56.5%) had serum 25(OH)D < 20 ng/ml, 61 (33.5%) had 20 - 29 ng/mL, and 18 (9.9%) had ≥ 30 ng/mL. The association between vitamin D status and socioeconomic indicators was assessed using the chi-square test or Fischer's exact test. Significant associations were found with total household income/month (P = 0.006), and income to poverty ratio (P = 0.005).
Conclusions: Women living in low-income houses and poverty have a higher prevalence of vitamin D deficiency.

Keywords: Vitamin D Status, Socioeconomic Status, Women, Eastern Nepal

1. Background

Vitamin D is crucial for maintaining women's health. The adverse consequences of vitamin D deficiency can extend beyond a woman's health to that of their offspring leading to preterm birth, impaired fetal skeleton formation, and childhood rickets (1). Empirical studies have uncovered many determinants of vitamin D deficiency; however, few have explored its relationship with socioeconomic status (2).

Sun exposure is a major source of vitamin D, followed by nutritional sources like oily fish and mushrooms (3). Sun avoiding behavior, such as wearing sunscreen for cosmetic reasons or otherwise, and sociocultural practices confining women within the household can diminish vitamin D levels. Furthermore, poverty and gender gaps in food security hinder women from accessing nutritional sources (4). These socioeconomic constraints shape our way of life and the daily health-related choices we make. These choices, in the long run, can have significant health implications.

2. Objectives

From this perspective, we conducted our study to analyze the socioeconomic aspects of women's lives in eastern Nepal and its association with health outcomes such as vitamin D deficiency.

3. Methods

The data for this study has been obtained from a previous community-based study estimating vitamin D deficiency. The ethical approval for this study was received from the Institutional Review Committee of B.P Koirala Institute of Health Sciences.

3.1. Socioeconomic Status

The socioeconomic status was determined using the following indicators: Educational status, stipulating the highest degree achieved (primary school, middle school, high school or above), educational status of the head of the household (primary school, middle school, high school,

and greater than high school), occupation of the woman and the head of the household (professional worker, semi-professional worker, clerical/shop owner/farmer, skilled or semi-skilled worker, unskilled worker, and unemployed) (5), total household income per month in Nepalese rupees (< 11,000, 12,000 - 24,000, 25,000 - 39,999, and ≥ 40,000), and income to poverty ratio. The ratio of a family's income to their threshold income determined the income to poverty ratio. The official monetary threshold income based on the Central Bureau of Statistics in Nepal in local prices is NRs 19, 261 per person per year (6). The income to poverty ratio was then classified as poverty and near poverty: 0 - 1.9 ratio; middle income: 2 - 3.9 ratio; and high income: ≥ 4 ratio. Socioeconomic status (SES) was defined using the collective score of educational status and occupation of the head of the household and the total monthly family income (5).

3.2. Covariates

Several potential confounding variables were assessed, which included age group (below 45 years and 45 years or above), caste/ethnic groups (Khas Aryan, Adibasi Janajati, and Other: Madhesi, Newars, Marwadi), (7) marital status (married and other: Unmarried, divorced, widowed), and premenopausal and post-menopausal group. Physical activity (active: Exercises more than half an hour per day for at least five days per week, moderate: Exercises with a duration less than for active, and sedentary: Irregular exercise or no physical activity). Self-reported ailments included fatigue, aches and pains, gastritis, miscellaneous (tingling, numbness, gynecological complaints, hypertension, and allergies), and none.

3.3. Vitamin D Status

We obtained venous blood samples sterilely, centrifuged them, and separated the sera. Chemiluminescence Immunoassay (Maglumi 1000 analyzer SNIBE Co., Ltd., China) was used to measure serum 25(OH)D. Proper test performance was ensured by adherence to the operating instructions of Maglumi. Serum 25(OH)D was categorized as vitamin D deficient (< 20 ng/mL), insufficient (20 - 29 ng/mL), and sufficient (30 - 100 ng/mL) (8).

3.4. Statistical Analysis

Data were analyzed using IBM SPSS version 11 (SPSS Inc., Chicago, USA). Normality of data distribution was assessed with the Kolmogorov-Smirnov. The indicators of socioeconomic status and covariates were examined against different categories of vitamin D status by cross-tabulation. The chi-square test or Fischer's exact test was employed to test the associations. P value < 0.05 was considered significant.

4. Results

4.1. Demographics

Out of 182 women, 103 (56.5%) had vitamin D deficiency, 61 (33.5%) had insufficiency, and 18 (9.9%) had sufficient vitamin D. 96 (52.7%) were aged 18 - 44, and 86 (47.3%) were above 45 years old. Caste/group distributions were as follows: Khas Aryan 75 (41.2%), Adibasi Janajati 72 (39.6), and others 35 (19.2%). Besides, 77 (42.3%) women were in the menopause stage, and 146 (80.2%) were married. Moreover, 87 (47.8%) did not report any ailments, while 34 (18.7%) complained of aches and pains, and 20 (10.9%) complained of fatigue.

4.2. Socioeconomic Status

Overall, 8 (4.4%) participants were living below the poverty line, 30 (16.5%) near the poverty line, and 144 (79.1%) above the poverty line. Most women, 70 (38.5%), and the heads of the household, 69 (37.9%), were educated till middle school. Also, 88 (48.4%) women were unemployed, 28 (15.4%) had skilled or semi-skilled work, 26 (14.3%) were clerical/shop owners/farmers, and 24 (13.2%) had unskilled jobs. The majority of the heads of the household had skilled or semi-skilled work, 65 (35.7%). The majority, 70 (38.5%), had a monthly income between 12,000 - 24,000 rupees. Also, 44 (24.2%) had a monthly income above 25,000 but below 40,000 rupees, and 33 (18.1%) had a monthly income above 40,000 rupees. Out of the total 48.4% belonged to lower-class families and 20.9% had income near or below the poverty line (Table 1).

4.3. Vitamin D (Serum 25(OH)D)

The median (25th - 75th) serum 25(OH)D was 18.6 (14.3 - 23.9). The median serum 25(OH)D was 15.3 ng/mL (12.7 - 17.3), 23.5 ng/mL (21.7 - 27.7), and 32.8 ng/mL (31 - 36.1) for vitamin D deficient, insufficient, and sufficient groups, respectively. (Figure 1) Similarly, among categories of the income to poverty ratio, the median serum 25(OH)D was 15.8 (12.1 - 18.6) ng/mL, 19 (15.3 - 24.4) ng/mL, and 20.6 ng/mL (15.2 - 26.2) for living in poverty, near poverty, and above poverty, respectively (P = 0.008 from Kruskal-Wallis test). (Figure 2) There was a significant association between vitamin D status and total household income per month (P = 0.006; Fischer's exact test) and the income to poverty ratio (P = 0.005; Chi-square test) (Table 1).

5. Discussion

Vitamin D deficiency affects one billion people worldwide, with a higher prevalence in women (9). In our study,

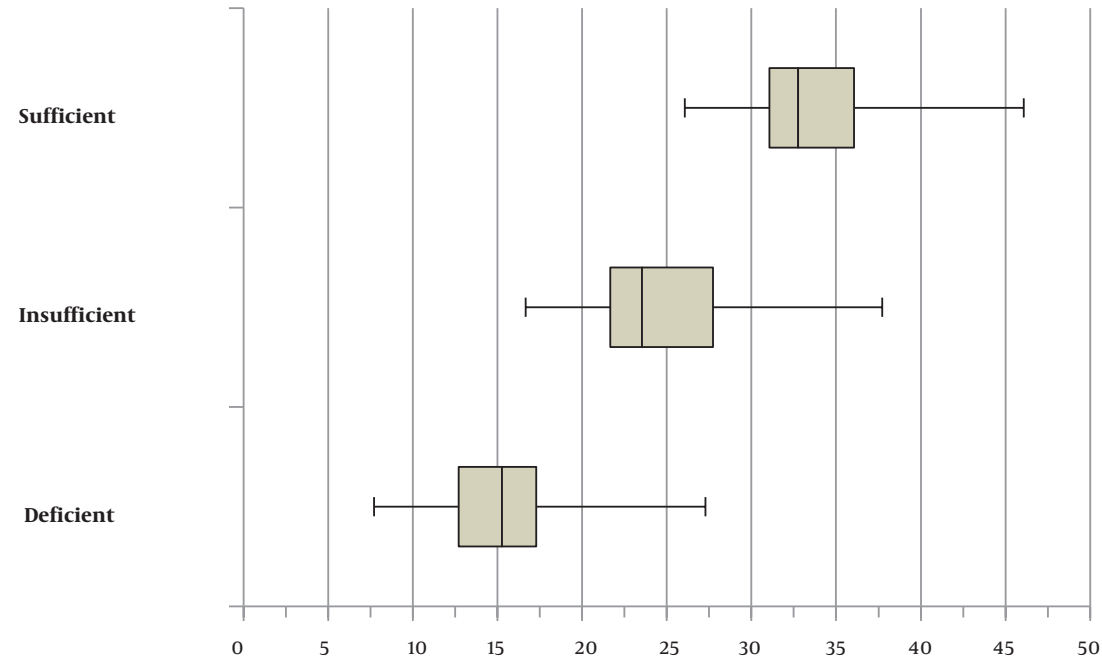

Figure 1. Box-and-Whisker plot showing median vitamin D among vitamin D status groups (deficient, insufficient, and sufficient). The median (25th-75th) serum 25(OH)D was 15.3 (12.7 - 17.3) in vitamin D deficient, 23.5 (21.7 - 27.7) in vitamin D insufficient, and 32.8 (31 - 36.1) in vitamin D sufficient categories.

more than half the study population had vitamin D deficiency (serum 25(OH)D level < 20 ng/mL), while one-fourth had vitamin D insufficiency (serum 25(OH)D level 20 - 29 ng/mL). We explored if such a high prevalence was attributed to socioeconomic factors.

We investigated many socioeconomic indicators of women in eastern Nepal. Overall, 38 (20.9%) lived below or near the poverty line. This was comparable to the national data, where 25.2% of the population fell under the poverty line using the national poverty threshold (10). The income to poverty ratio considers the number of mouths to be fed in proportion to the family's income and thus reflects if the family can purchase adequate amounts for each member. In our study, this was well reflected, as vitamin D deficiency was more prevalent in impoverished families.

There was a significant association between vitamin D deficiency and lower income. Our finding was in agreement with many empirical studies conducted earlier displaying a significant correlation between household income and vitamin D status (2, 11). Lower income restrains the purchasing power directing money to fulfill daily necessities such as food, clothing, and shelter rather than buying vitamin D supplements or fortified food. The quality of food purchased itself may be substandard and unable to fulfill the daily needs of vitamin D.

We also found that 48.4% of our participants were unemployed, thus not contributing to the total household income. This highlights the need for the economic empowerment of women. As total household income is the gross income generated by all family members, having an unemployed member can significantly bring it down.

Other individual indicators of SES as education and occupation did not show significant association with vitamin D status. Besides the individual indicators of SES, we also generated an aggregate using Kuppuswamy's Socioeconomic Status tool. Categorizing into such socioeconomic class considers not only monetary terms but also education and occupation. Many studies have demonstrated a significant association between vitamin D deficiency and lower socioeconomic status (12, 13). However, we did not find any significant association between socioeconomic status and vitamin D.

5.1. Conclusions

Our findings show that women living in low-income houses and poverty have a higher prevalence of vitamin D deficiency. This study highlights the need for economic empowerment of women and establishing food fortification and nutrient supplementation programs.

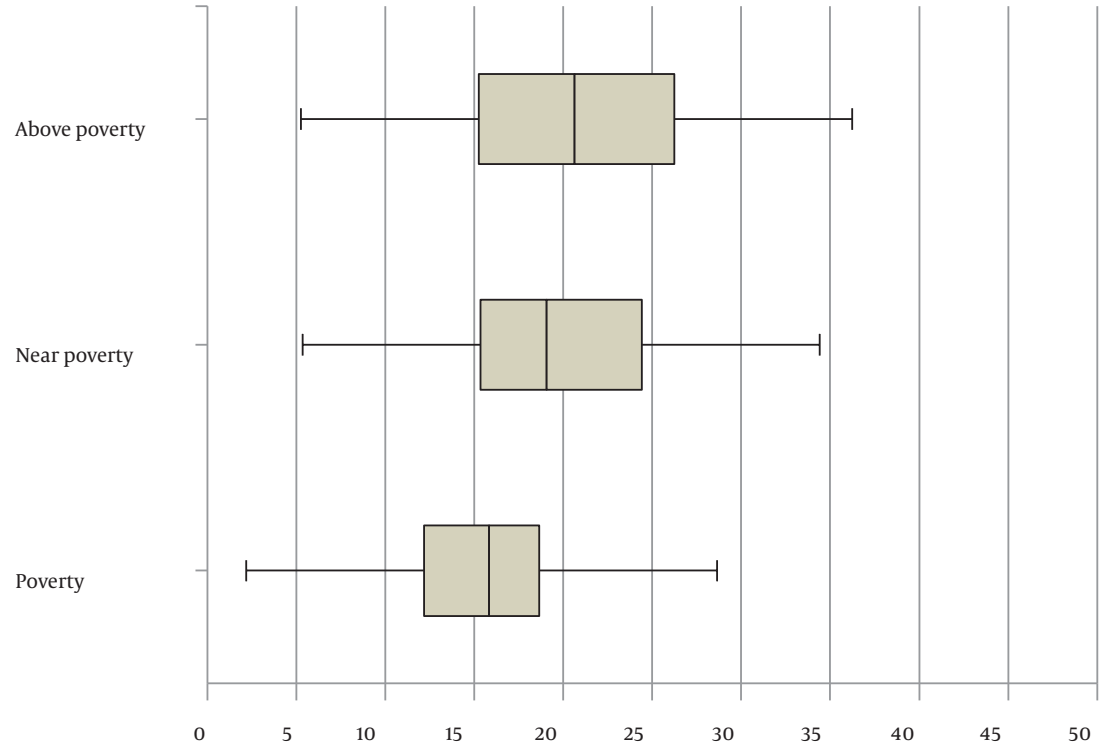

Figure 2. Box-and-Whisker plot showing median vitamin D in groups with different living standards (above poverty, near poverty, and poverty).; The median (25th - 75th) serum 25(OH)D was 15.8 (12.1 - 18.6), 19(15.3 - 24.4), and 20.6 (15.2 - 26.2) for living in poverty, near poverty, and above poverty groups, respectively (P = 0.008, from Kruskal-Wallis test).

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Footnotes

Authors' Contribution: Ojaswee Sherchand was responsible for concept building, designing the study, literature search, data collection, data analysis, statistical analysis, research supervision, and manuscript preparation. Jouslin Kishore Baranwal was involved in literature search, data collection, blood sampling, and manuscript preparation. Basanta Gelal was involved in blood sampling, laboratory tests, reagent procurement, and data analysis.

Conflict of Interests: We do not have any potential conflicts of interest concerning the research, authorship, and/or publication of this article.

Data Reproducibility: The data will be made available by the author on reasonable request. The data for this study has been derived from a previous study done in eastern Nepal (Sherchand O, Baranwal JK, Gelal B. Epidemiology and determinants of vitamin D deficiency in Eastern Nepal: A community-based, cross-sectional study [preprint]. medRxiv. 2022 Jan 1.)

Ethical Approval: This study is approved under ethical approval from the Institutional Review Committee, B.P Koirala Institute of Health Sciences (IRC/1220/018).

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Informed Consent: Informed consent was obtained.

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Table 1. Serum 25(OH)D Status Amongst Baseline Variables [a]

Variables and Sub-categories	Total Count; No. (%)	Vitamin D Status; No. (%)			P-Value [a]
		Deficient	Insufficient	Sufficient	
Indicators of Socioeconomic Status					
Education status					0.05
Primary school	47 (25.8)	24 (13.2)	17 (9.3)	6 (3.3)	
Middle school	70 (38.5)	47 (25.8)	15 (8.2)	8 (4.4)	
High school or above	65 (35.7)	32 (17.6)	29 (15.9)	4 (2.2)	
Education status of the head of the household					0.06
Primary school	47 (25.8)	24 (13.2)	17 (9.3)	6 (3.3)	
Middle school	69 (37.9)	46 (25.3)	15 (8.2)	8 (4.4)	
High school	40 (22.0)	17 (9.3)	21 (11.5)	2 (1.1)	
Greater than high school	26 (14.3)	16 (8.8)	8 (4.4)	2 (1.1)	
Women's occupation					0.6
Professional, semi-professional	16 (8.8)	8 (4.4)	7 (3.8)	1 (0.5)	
Skilled and semi-skilled	28 (15.4)	17 (9.3)	8 (4.4)	3 (1.6)	
Clerical/shop owner/farmer	26 (14.3)	12 (6.6)	11 (6)	3 (1.6)	
Unskilled	24 (13.2)	18 (9.9)	4 (2.2)	2 (1.1)	
Unemployed	88 (48.4)	48 (26.4)	31 (17)	9 (4.9)	
Occupation of the head of the household					0.06
Professional, semi-professional	27 (14.8)	16 (8.8)	8 (4.4)	3 (1.6)	
Skilled and semi-skilled	65 (35.7)	43 (23.6)	16 (8.8)	6 (3.3)	
Clerical/shop owner/farmer	53 (29.1)	23 (12.6)	25 (13.7)	5 (2.7)	
Unskilled	28 (15.4)	19 (10.4)	6 (3.3)	3 (1.6)	
Unemployed	9 (4.9)	2 (1.1)	6 (3.3)	1 (0.5)	
Total household income/month (Nepalese rupees)					0.006 [b]
11,000 or lesser	35 (19.2)	29 (15.9)	4 (2.2)	2 (1.1)	
12,000 - 24,000	70 (38.5)	36 (19.8)	23 (12.6)	11 (6)	
25,000 - 39,999	44 (24.2)	22 (12.1)	20 (11)	2 (1.1)	
40,000 or more	33 (18.1)	16 (8.8)	14 (7.7)	3 (1.6)	
Income to poverty ratio					0.005 [c]
Poverty and near poverty	38 (20.9)	31 (17)	6 (3.3)	1 (0.5)	
Middle income	63 (34.6)	34 (18.7)	20 (11)	9 (4.9)	
High income	81 (44.5)	38 (20.9)	35 (19.2)	8 (4.4)	
Socioeconomic status					0.7
Upper middle or above	41 (22.5)	24 (13.2)	14 (7.7)	3 (1.6)	
Lower middle	53 (29.1)	27 (14.8)	21 (11.5)	5 (2.7)	
Lower class	88 (48.4)	52 (28.6)	26 (14.3)	10 (5.5)	
Covariates					
Age groups					0.5
Below 45 years	96 (52.7)	51 (28)	36 (19.8)	9 (4.9)	
45 years or above	86 (47.3)	52 (28.6)	25 (13.7)	9 (4.9)	
Caste/ethnic groups					0.6
Khas Aryan	75 (41.2)	46 (22.5)	26 (14.3)	8 (4.4)	
Adibasi Janajati	72 (39.6)	45 (24.7)	22 (12.1)	5 (2.7)	
Others	35 (19.2)	17 (9.3)	13 (7.1)	5 (2.7)	
Menstrual status					0.6
Menopause	77 (42.3)	46 (25.3)	23 (12.6)	8 (4.4)	

Not menopause	105 (57.7)	57 (31.3)	38 (20.9)	10 (5.5)	
Marital status					0.1
Married	146 (80.2)	87 (47.8)	44 (24.2)	15 (8.2)	
Other	36 (19.8)	16 (8.8)	17 (9.3)	3 (1.6)	
Physical activities					0.9
Moderate	41 (22.5)	22 (12.1)	15 (8.2)	4 (2.2)	
Active	43 (23.6)	27 (14.8)	12 (6.6)	4 (2.2)	
Sedentary	98 (53.8)	54 (29.7)	34 (18.7)	10 (5.5)	
Self-reported ailments					0.9
Fatigue	20 (10.9)	13 (7.1)	6 (3.3)	1 (0.5)	
Aches and pains	34 (18.7)	18 (9.9)	12 (6.6)	4 (2.2)	
Gastritis	11 (6)	7 (3.8)	3 (1.6)	1 (0.5)	
Miscellaneous	30 (16.5)	15 (8.2)	11 (6)	4 (2.2)	
None	87 (47.8)	50 (27.5)	29 (15.9)	8 (4.4)	

[a] P value obtained from χ^2 test.
[b] Fisher's exact test.
[c] P value < 0.05 is considered significant.