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: In this cross-sectional study, we recruited 182 women aged 18 to 65 years from eastern Nepal. 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 (14.3 - 23.9 ng/ml). Of women, 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, showing a significant association with total household income per 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: Women living in low-income houses and poverty have a higher prevalence of vitamin D deficiency.

1. Background

Vitamin D is crucial for maintaining women’s health. The adverse consequences of vitamin D deficiency can extend beyond women’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 their association with health outcomes, i.e., vitamin D deficiency.

3. Methods

In this cross-sectional study, we recruited 182 women aged 18 to 65 years from eastern Nepal irrespective of their ethnicity, socioeconomic status, and geographical region of residence. 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: a 0 - 1.9 ratio; middle income: a 2 - 3.9 ratio; and high income: a ≥ 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 steriley, 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 adhering 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. Median (25th - 75th) serum 25(OH)D was measured across vitamin D status groups and living standards. The significance of associations was established using the Kruskal-Wallis test. 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%) were sufficient. Also, 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, eight (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. Most participants belonged to lower-class families, 88 (48.4%). Also, 38 (20.9%) had an 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). Overall, 103 (56.5%) were vitamin D deficient, 61 (33.5%) had vitamin D insufficiency, and 18 (9.9%) had sufficient levels of vitamin D. 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, 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. Of the participating women, 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.

Also, 4.4% of our study population had incomes below the threshold. 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.

Vitamin D status did not display significant variation across the categories of education and occupation. 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.

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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: Sanothimi, Bhaktapur, Nepal (UGC Faculty Research Grant for FRG-73/74-HS-04). We conducted this research with the common motivation to find the determinants of vitamin D deficiency in women, focusing on socioeconomic and dietary factors. 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.

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

| Variables and Sub-categories | Total Count; No. (%) | Vitamin D Status; No. (%) | P-Value a | Indicators of Socioeconomic status |
|------------------------------|----------------------|---------------------------|-----------|-----------------------------------|
| **Indicators of Socioeconomic status** | | | | 0.05 |
| Education status | | | | |
| 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) | 10(5.6) | 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(10) | 2(1.1) |
| 40,000 or more | 13(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(10.1) | 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) | 20(10.5) | 5(2.7) |
| Lower class | 88(48.4) | 52(28.6) | 26(14.3) | 10(5.5) |
| **Covariates** | | | | 0.5 |
| Age groups | | | | |
| 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(25.3) | 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 | Marital status | Physical activities | Self-reported ailments |
|--------------------------------|---------------|----------------|---------------------|------------------------|
|                                |               | 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                       | 4(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)                 |

* P value obtained from χ² test.

b Fisher’s exact test.

c P value < 0.05 is considered significant.