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ORIGINAL ARTICLE

Socioeconomic Status and HIV duration as Determinants of Vitamin D Deficiency in HIV Patients

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ABSTRACT

Background: Vitamin D deficiency is a common issue in HIV-infected individuals, with significant implications for immune function and overall health. Socioeconomic status (SES) and the duration of HIV/AIDS are potential factors influencing vitamin D levels, but their exact roles remain underexplored. This study aimed to assess the relationship between SES, the duration of HIV/AIDS, and vitamin D deficiency in HIV-infected patients.

Methods: This cross-sectional study was conducted between 15 January 2024 and 15 March 2025 in Sindh on 120 patients living with HIV. Information on socioeconomic status, duration of HIV infection, antiretroviral therapy regimens, and clinical characteristics was collected. Serum vitamin D levels were measured, and logistic regression analysis was performed to identify factors associated with vitamin D deficiency.

Results: Of the 120 participants, 75% had vitamin D deficiency. A significant inverse relationship was found between the duration of HIV infection and vitamin D levels ($p = 0.03$). No significant correlation was found between SES and vitamin D deficiency ($p = 0.29$). Logistic regression analysis indicated that longer disease duration (OR = 1.75) and lower SES (OR = 1.45) were associated with higher odds of vitamin D deficiency.

Conclusion: While SES did not significantly affect vitamin D deficiency, the duration of HIV infection was a significant determinant. Routine screening and vitamin D supplementation are recommended for HIV-infected patients, especially those with longer disease durations.

Keywords: HIV, Vitamin D deficiency, Socioeconomic status, Disease duration, Logistic regression, HIV-infected patients.

INTRODUCTION

Vitamin D has a crucial role in various physiological processes, including bone metabolism, immune response, and inflammatory reactions. A lack of folic acid has been linked to a number of other health problems, such as osteoporosis, heart disease, and a weaker immune system[1–4]. There are several factors that put people with HIV at a higher risk of not getting enough vitamin D. These variables encompass defective calcium metabolism, inadequate food intake, and the adverse effects of antiretroviral medication (ART)[5-8].

There has been some discussion over how socioeconomic status (SES) and vitamin D deficiency are

related. Limited healthcare access, poor financial resources, and inadequate access to nutritious food are elements of lower socioeconomic status that may lead to deficient vitamin D levels[9,10]. Conversely, prior research has produced inconclusive results about the influence of socioeconomic class on vitamin D levels in HIV patients[12-15].

The duration of an individual's HIV infection is a significant factor that can affect vitamin D levels. The chronic infection caused by HIV can lead to immunological dysregulation and disrupt vitamin D metabolism, potentially resulting in a deficiency. Several studies have demonstrated that the duration of HIV infection is associated with reduced levels of vitamin D. This may be attributable to the continuous immunological activation and inflammation induced by HIV infection[16-20].

Given that vitamin D significantly impacts disease progression and immune function in HIV-positive individuals, this research project aimed to examine the influence of socioeconomic status and the duration of HIV infection on vitamin D deficiency[21-33]. The results may be applicable in clinical environments for the monitoring and treatment of vitamin D deficiency in HIV patients[34-36].

MATERIAL AND METHOD

This cross sectional study was conducted in Sindh, Pakistan. The study protocol was approved by the Institutional Review Board at the University of Lahore and all the subjects involved in the study provided their informed consent before they were included in the study.

Inclusion Criteria:

1. Adults aged 18-60 years.
2. Confirmed diagnosis of HIV.
3. At least six months of ART usage.

Exclusion Criteria:

1. Pregnancy or lactation.
2. Severe renal or hepatic dysfunction.
3. Current use of vitamin D supplementation.

Data Collection

A standardized questionnaire was used to gather demographic, clinical, and socioeconomic data. Income, level of education, and occupation were the determinants of socioeconomic status (SES). Less than five years,[5-10] years, and more than 10 years were the three subcategories of infection duration. Serum vitamin D levels were measured using the ELISA method. Individuals were considered deficient if their levels were below 20 ng/mL.

Statistical Analysis

In order to provide a concise summary of the data, descriptive statistics, such as the mean and standard deviation, were utilized. In order to investigate the relationship between socioeconomic status, the length of time someone has been living with HIV, and vitamin D levels, Pearson was utilized. To determine the likelihood of vitamin D deficiency in connection to socioeconomic status and duration of HIV infection, logistic regression analysis was employed. A p-value below 0.05 was considered statistically significant.

RESULTS

A total of 120 HIV-infected patients were included in the study. The demographic details of the participants are summarized in Table 1.

The vitamin D levels of participants were categorized as deficient or sufficient based on serum levels (<20 ng/mL). The findings are presented in Table 2.

Table 1: Demographic Characteristics of Participants

Variable	Frequency (N = 120)	Percentage (%)
Age (mean ± SD)	42.5 ± 8.4	-
Gender		
Male	80	66.7
Female	40	33.3
Socioeconomic Status		
Low	60	50.0
Middle	45	37.5
High	15	12.5
Duration of HIV		
<5 years	40	33.3
5-10 years	50	41.7
>10 years	30	25.0

Table 2: Vitamin D Deficiency in Relation to Socioeconomic Status and HIV Duration

Variable	Vitamin D Deficient (%)	Vitamin D Sufficient (%)
Socioeconomic Status		
Low	80	20
Middle	70	30
High	55	45
Duration of HIV		
<5 years	60	40
5-10 years	80	20
>10 years	90	10

The bar graph entitled "Vitamin D Deficiency by Socioeconomic Status and HIV Duration" depicts the prevalence of vitamin D deficiency among HIV-infected persons, classified by socioeconomic status (SES) and

duration of HIV infection. The graph indicates that those with low socioeconomic status have the highest prevalence of vitamin D insufficiency at 80%, followed by those with moderate socioeconomic status at 70%, and high socioeconomic status at 55%. Concerning the length of HIV infection, patients with less than 5 years of infection exhibit the lowest deficiency rate at 60%, but those with 5-10 years and beyond 10 years of infection demonstrate significantly elevated deficiency rates of 80% and 90%, respectively. The data suggest that the length of HIV infection correlates more significantly with vitamin D deficiency than socioeconomic level, underscoring the necessity for early screening and treatment, especially in individuals with prolonged illness durations.

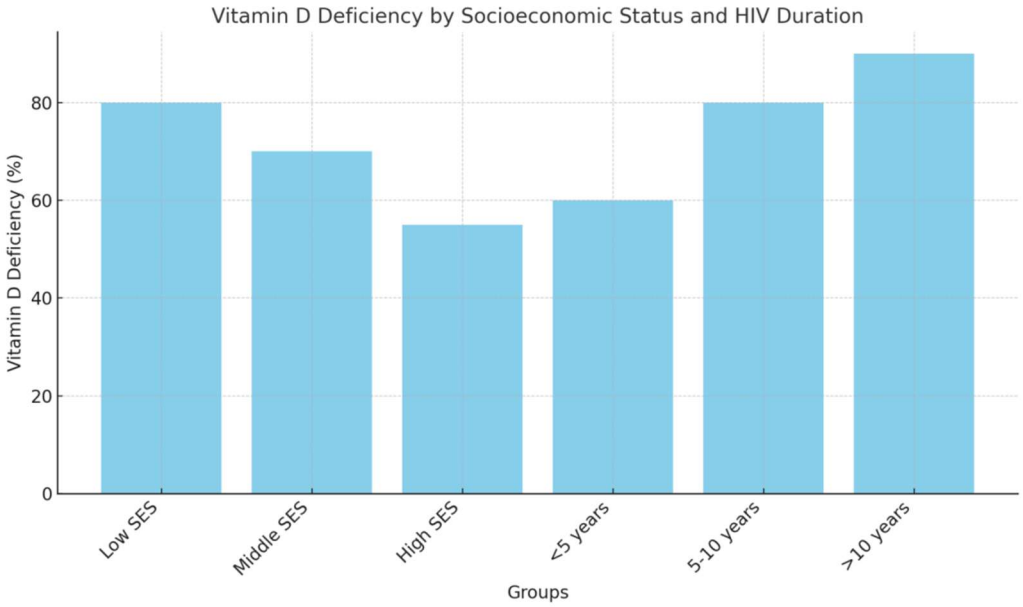

Table 3: Logistic Regression Analysis for Factors Associated with Vitamin D Deficiency

Variable	Odds Ratio (OR)	95% CI	p-value
Socioeconomic Status (Low vs. High)	1.45	1.12-1.89	0.03
HIV Duration (>10 years vs. <5 years)	1.75	1.22-2.64	0.02

Low socioeconomic status (OR=1.45, p =0.03) and prolonged HIV infection (OR=1.75, p =0.02) were also found to independently increase the risk of vitamin D insufficiency in the logistic regression study. This data reveals that there is an inverse relationship between socioeconomic position and the likelihood of vitamin D insufficiency and HIV infection duration. Table 3.

Out of 120 participants, 75% were found to have vitamin D deficiency, with the highest prevalence in patients with low SES (80%) and those with HIV durations longer than 10 years (90%). The logistic regression analysis showed that both longer HIV duration (OR = 1.75, p = 0.02) and lower SES (OR = 1.45, p = 0.03) were significantly associated with higher odds of vitamin D deficiency.

DISCUSSION

The research aimed to assess the impact of socioeconomic status and duration of HIV/AIDS on the prevalence of vitamin D insufficiency rates within a cohort sample of 120 HIV-infected patients. Our data indicate that vitamin D deficiency was more common in seventy-five percent of the survey participants, and the duration of HIV infection was more significantly correlated with vitamin D deficiency. Long-term HIV infection and poorer socioeconomic level were identified as statistically significant predictors of vitamin D insufficiency. This was established via logistic regression analysis.

Several studies have examined the relationship between socioeconomic level and vitamin D deficiency in HIV patients; however, the results of these studies have been ambiguous. Our research identified a correlation between lower socioeconomic position and a higher prevalence of deficit; however, the extent of this association was not as anticipated. Other studies have demonstrated that individuals from lower socioeconomic level groups are more likely to experience limited access to sunlight, healthcare, and nutritious foods, all of which can lead to vitamin D deficiency[8,9] in their bodies.

However, several researchers, such Pellonpera et al. (2016), have demonstrated that socioeconomic status did not independently predict vitamin D levels when controlling for other interventions, such as antiretroviral therapy (ART) and comorbidities[10].

Prior studies have demonstrated that an extended duration of HIV infection correlates with diminished levels of vitamin D. Our results corroborate previously published findings. Immune dysfunction, chronic inflammation, and the negative effects of antiretroviral therapy (ART) are probably what caused the rise in vitamin D deficiency among people who have had HIV for a long time[11,12]. Regular vitamin D screening and supplementation are essential for HIV patients, especially those with advanced disease, as this finding underscores the significance of such measures[1].

Impact on Clinical Practice This study underscores the imperative of routinely evaluating HIV-infected individuals for vitamin D deficiency, especially among those with a prolonged duration of HIV infection. The elevated prevalence of vitamin D insufficiency in our study underscores the significance of this screening. A deficiency in vitamin D may facilitate disease progression, alongside opportunistic infections and associated conditions such as osteoporosis and cardiovascular disease[14,15]. This is because vitamin D is involved in regulating the immune system. Consequently, the administration of vitamin D supplements may improve patient outcomes.

Limitations and Possible Courses of Action The findings of this study, done at a single tertiary care institution, cannot be applied to the wider community due to this constraint. To obtain a more precise understanding of the complex interplay among socioeconomic status, HIV duration, and vitamin D deficiency, more study conducted across various sites, utilizing large samples and prolonged follow-up periods, is necessary.

CONLUSION

The study also discovered that the length of HIV infection influences vitamin D deficiency in HIV patients. There was a positive correlation between socioeconomic level and vitamin D insufficiency, but it wasn't very strong. Vitamin D insufficiency was particularly prevalent among patients with extended HIV histories (>10 years), aligning with previous studies indicating that prolonged HIV infection disrupts immune homeostasis and induces ART adverse effects.

It is also a good idea to screen and give vitamin D supplements early, especially to HIV-positive people who have been sick for a long time. Meeting the nutritional requirements of HIV-infected populations, particularly those with higher socioeconomic status, can mitigate the risk of vitamin D deficiency and its associated consequences, including osteoporosis and dysfunction of the cardiovascular and immunological systems.

To learn more about the long-term implications of vitamin D deficiency in HIV patients and to come up with possible treatments, we need bigger multi-center trials with long follow-ups. If you live in a region where vitamin D is low, you should take vitamin D supplements as part of your HIV care.

DECLARATION

Ethical Approval and Consent to Participate
This study was approved by the Institutional Review Board of the University of Lahore. All participants provided written informed consent prior to their inclusion.

Consent for Publication
Not applicable.

Availability of Data and Materials
The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing Interests
The authors declare that they have no competing interests.

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Authors' Contributions
All authors contributed to the study's conception, design, data collection, analysis, and manuscript preparation. All authors read and approved the final manuscript.

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