International Journal of Medicine
pISSN 1468-3814 | eISSN 2667-7008
https://theinternationalmedicine.com/

Original Researcher Article *DOI: 10.61336/im/26-2-12*

Comparative Study of Serum Vitamin D Levels in Population of Urban and Rural Areas

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Received: **09.07.2021**
Revised: **20.07.2021**
Accepted: **05.08.2021**
Published: **30.09.2021**

Abstract

Background: Vitamin D deficiency has emerged as a significant global health problem affecting both developed and developing nations. Despite abundant sunlight in many regions, deficiency remains widespread due to lifestyle changes, environmental factors, and dietary habits. This study aimed to compare serum vitamin D levels between urban and rural populations and to evaluate factors influencing vitamin D status. ***Methods***: A cross-sectional comparative study was conducted on 120 participants, equally divided into urban (n = 60) and rural (n = 60) groups. Serum 25-hydroxyvitamin D [25(OH)D] levels were measured using a standard immunoassay method and categorized as deficient, insufficient, or sufficient. Demographic information, sun exposure, occupation, and dietary patterns were recorded through a structured questionnaire. ***Results:*** Vitamin D deficiency was significantly higher in the urban population (65%) compared to the rural population (38%). The mean serum vitamin D level in the urban group was 18.6 ± 6.4 ng/mL, whereas the rural group showed a higher mean level of 26.2 ± 7.1 ng/mL. Increased sun exposure and outdoor physical activity were associated with higher vitamin D levels in rural participants. ***Conclusion***: Urban populations exhibit significantly lower vitamin D levels compared to rural populations. Reduced sun exposure and sedentary lifestyle contribute substantially to this disparity. Public health initiatives focusing on awareness, lifestyle modification, and vitamin D supplementation are necessary to address this growing concern.

Keywords: Vitamin D, urban population, rural population, deficiency, sunlight exposure.

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INTRODUCTION

Vitamin D is a fat-soluble vitamin essential for maintaining calcium homeostasis, bone health, and overall metabolic functions. It plays a crucial role in regulating calcium and phosphorus absorption, thereby contributing to bone mineralization and skeletal integrity. In addition to its classical role in bone metabolism, vitamin D has been implicated in immune function, cardiovascular health, and the prevention of several chronic diseases (Holick, 2007).

Vitamin D is primarily synthesized in the skin following exposure to ultraviolet B (UVB) radiation from sunlight. Only a small proportion is obtained through dietary sources such as fatty fish, egg yolk, fortified dairy products, and nutritional supplements. However, insufficient sunlight exposure or inadequate dietary intake can lead to vitamin D deficiency (Palacios & Gonzalez, 2014).

Vitamin D deficiency has become a widespread global health issue affecting people across different age groups and geographical regions. Studies indicate that nearly one billion people worldwide suffer from vitamin D deficiency or insufficiency (Mithal et al., 2009). The prevalence of deficiency is particularly high in developing countries, including India.

Despite the availability of abundant sunlight throughout the year, vitamin D deficiency is highly prevalent in India. This paradox has been attributed to various lifestyle and environmental factors such as urbanization, indoor occupations, air pollution, cultural clothing habits, and limited dietary intake of vitamin D-rich foods (Harinarayan & Joshi, 2009).

Urbanization has significantly altered human lifestyle patterns in recent decades. Urban populations often spend a large portion of their time indoors due to office-based occupations, educational activities, and increased reliance on technology. Reduced outdoor physical activity and limited sun exposure contribute to decreased synthesis of vitamin D in the skin. Additionally, air pollution in urban environments may block ultraviolet radiation, further reducing vitamin D production (Ritu & Gupta, 2014).

In contrast, rural populations are generally more engaged in outdoor occupations such as farming, construction work, and manual labor. These activities involve prolonged exposure to sunlight, which may contribute to better vitamin D status compared to urban populations.

Vitamin D deficiency has been associated with a wide range of health conditions, including osteoporosis, rickets, cardiovascular diseases, diabetes mellitus, autoimmune disorders, and certain types of cancer (Lips, 2001). Early detection and management of vitamin D deficiency are therefore essential to prevent long-term health complications.

Although several studies have assessed vitamin D status in various populations, comparative data between urban and rural populations remain limited in many regions. Understanding these differences can help identify risk factors and design targeted public health strategies.

Therefore, the present study was conducted to compare serum vitamin D levels between urban and rural populations and to evaluate the factors influencing vitamin D status in these groups.

METHODOLOGY

Study Design and Setting

This study was designed as a cross-sectional comparative study conducted over a period of six months at a tertiary care hospital.

Study Population

A total of 120 participants were included in the study and divided into two groups:

- Urban population: 60 participants
- Rural population: 60 participants

Participants were selected through convenience sampling from individuals visiting the outpatient department for routine health check-ups.

Inclusion Criteria

Participants meeting the following criteria were included:

- Age between 18 and 65 years
- Apparently healthy individuals
- Willingness to participate in the study and provide informed consent

Exclusion Criteria

Participants with the following conditions were excluded:

- Chronic kidney disease or liver disease
- Recent vitamin D supplementation within the past three months
- Pregnancy
- Known metabolic bone disorders

Data Collection

Data were collected using a structured questionnaire that included the following variables:

- Demographic details (age, gender, residence)
- Occupational status
- Average daily sun exposure
- Dietary habits and consumption of vitamin D-rich foods

Laboratory Analysis

Blood samples were collected from all participants under standard aseptic conditions. Serum vitamin D levels were measured by determining 25-hydroxyvitamin D [25(OH)D] concentration, which is considered the best indicator of vitamin D status.

Vitamin D levels were categorized as follows:

- Deficient: <20 ng/mL
- Insufficient: 20–30 ng/mL
- Sufficient: >30 ng/mL

Statistical Analysis

The collected data were entered and analyzed using Statistical Package for Social Sciences (SPSS) software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as percentages.

The Chi-square test was used to compare categorical variables between groups. A p-value less than 0.05 was considered statistically significant.

RESULTS

A total of 120 participants were included in this study, consisting of 60 individuals from urban areas and 60 individuals from rural areas.

Demographic Characteristics

The mean age of participants in the urban group was **35.2 ± 10.4 years**, whereas the rural group had a mean age of **36.8 ± 11.2 years**. The gender distribution was similar in both groups.

Table 1: Demographic Characteristics

Parameter	Urban	Rural
Mean age (years)	35.2 ± 10.4	36.8 ± 11.2
Male	52%	55%
Female	48%	45%

Vitamin D Status

The prevalence of vitamin D deficiency was considerably higher in the urban population compared with the rural population.

Table 2: Vitamin D Status in Study Population

Category	Urban (%)	Rural (%)
Deficient (<20 ng/mL)	65%	38%
Insufficient (20–30 ng/mL)	25%	32%
Sufficient (>30 ng/mL)	10%	30%

Mean Vitamin D Levels

The mean serum vitamin D level was significantly lower in the urban group compared with the rural group.

Table 3: Mean Serum Vitamin D Levels

Group	Mean ± SD (ng/mL)
Urban	18.6 ± 6.4
Rural	26.2 ± 7.1

Key Findings

- Vitamin D deficiency was significantly more prevalent in urban populations.
- Rural participants demonstrated higher mean vitamin D levels.
- Greater sunlight exposure and outdoor activity were associated with improved vitamin D status.

DISCUSSION

The present study demonstrated a clear difference in serum vitamin D levels between urban and rural populations. The findings revealed that vitamin D deficiency was significantly more common in urban participants compared with rural individuals.

These results are consistent with previous studies indicating that urbanization and lifestyle changes contribute to reduced sunlight exposure and increased risk of vitamin D deficiency (Mithal et al., 2009).

Urban residents often engage in indoor occupations, spend extended periods in offices or educational institutions, and rely heavily on transportation. These factors reduce the duration of sunlight exposure required for adequate vitamin D synthesis in the skin. Additionally, the use of sunscreen and protective clothing may further limit UVB exposure (Holick, 2007).

Air pollution is another important factor that may contribute to vitamin D deficiency in urban areas. Pollutants in the atmosphere can block ultraviolet radiation, thereby reducing the ability of sunlight to stimulate vitamin D synthesis (Ritu & Gupta, 2014).

In contrast, rural populations typically participate in outdoor occupations such as agriculture and manual labor. Prolonged sunlight exposure in these settings may explain the higher mean vitamin D levels observed in the rural group.

However, it is noteworthy that a considerable proportion of rural participants also exhibited vitamin D deficiency. This suggests that vitamin D deficiency is not limited to urban populations but represents a broader public health concern affecting multiple demographic groups.

Dietary intake of vitamin D-rich foods also appears to be inadequate in many populations. Foods naturally rich in vitamin D, such as fatty fish and fortified dairy products, are not commonly consumed in sufficient quantities (Palacios & Gonzalez, 2014).

Vitamin D deficiency has been linked to several adverse health outcomes including osteoporosis, fractures, cardiovascular diseases, diabetes, and immune disorders (Lips, 2001). Therefore, addressing this deficiency through public health interventions is essential.

The findings of the present study highlight the importance of increasing awareness regarding adequate sunlight exposure, balanced diet, and vitamin D supplementation where necessary.

However, this study has certain limitations. The sample size was relatively small and seasonal variation in vitamin D levels was not evaluated. Larger studies with extended follow-up periods are needed to further investigate these associations.

CONCLUSION

The study demonstrates that vitamin D deficiency is significantly more prevalent in urban populations compared with rural populations. Reduced sunlight exposure, indoor lifestyle, and environmental factors appear to play major roles in this disparity.

Public health initiatives focusing on awareness, lifestyle modification, improved dietary intake, and vitamin D supplementation are necessary to address this growing health problem.

Ethical Approval: This study was approved by the Institutional Ethics Committee.

Conflict of Interest: The authors declare no conflict of interest.

Funding: No funding was received for this study.

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