



Article

The Association Between Vitamin D Levels, Body Mass Index (BMI), and Dietary Patterns in Iraqi Women

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Abstract: Context The immune system, bone metabolism, and other metabolic processes are all significantly impacted by vitamin D. Numerous studies have found a negative correlation between body mass index (BMI) and blood vitamin D levels, indicating a connection between vitamin D deficiency and obesity. Even though Iraq receives a lot of sunlight, vitamin D insufficiency is nevertheless very common there, especially among women. The relationship between BMI and vitamin D levels in Iraqi women is not well understood, which calls for more investigation. The purpose of the study The study is to examine the relationship between BMI and the blood level of 25(OH)D in Iraqi women as well as the impact of sun exposure, physical activity, and vitamin D consumption on vitamin D status. Techniques In this study, 98 Iraqi women were divided into three BMI groups: normal weight (BMI < 25 kg/m²), overweight (BMI ≤ 30 kg/m²), and obese (BMI ≥ 30 kg/m²). Chemiluminescence immunoassay (CLIA) was used to measure serum 25(OH)D concentrations. Lifestyle variables were recorded, such as exposure to sunshine, physical activity (measured by daily steps taken), and vitamin D content of food. The relationship between BMI and vitamin D levels was evaluated using Pearson's correlation coefficient, and the variation in vitamin D levels between groups of individuals with varying BMIs was evaluated using a one-way ANOVA. To find independent variables related to the vitamin D status, multiple linear regression analysis was used. Outcomes The serum 25(OH)D level and BMI had an inverse relationship ($r = -0.41$, $p = 0.032$). Vitamin D levels were significantly lower in women who did not receive enough sunshine each day ($p = 0.014$). Serum vitamin D levels were adversely correlated with increased physical activity (6,000 steps per day) ($p = 0.027$). • According to regression analysis, individuals' vitamin D status was significantly impacted negatively by their BMI ($\beta = -0.34$, $p = 0.039$). In conclusion Compared to people of normal weight, Iraqi women who were overweight or obese had decreased vitamin D levels. The findings show that consuming dairy products, getting more sunshine, and engaging in more physical activity all improve vitamin D levels.

Citation: Jumaa A. M. The Association Between Vitamin D Levels, Body Mass Index (BMI), and Dietary Patterns in Iraqi Women. Central Asian Journal of Medical and Natural Science 2026, 7(2), 286-291.

Received: 10th Dec 2025

Revised: 13th Jan 2026

Accepted: 25th Feb 2026

Published: 03rd Mar 2026



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Keywords: Vitamin D, Body Mass Index, Sun Exposure, Obesity.

1. Introduction

Vitamin D has a crucial role in the health of bone, calcium regulation, and immunity [1]. It is hypothesized to organize the regulation of various metabolic processes, and its lack is associated with osteoporosis, heart disease, insulin resistance, and immune deficiency [2]. Recent research suggests that overweight and obese individuals have a higher percentage of having vitamin D deficiency; this could be due to the reduced availability of vitamin D in the adipose tissue of overweight individuals [4], [5]. Despite the fact that Iraq has a lot of sunlight, the deficiency of vitamin D is still common,

particularly among women [3]. The cultural practices of clothing, limited sunlight exposure, and insufficient dietary vitamin D all contribute to this deficiency [8]. However, information on the association between BMI and vitamin D levels in Iraqi women is limited. This investigation aims to assess the association between BMI and vitamin D levels while taking into account factors like sunlight exposure, physical activity, and dietary intake.

2. Materials and Methods

2.1.1 Study Design and Participant Information

A cross-sectional investigation was conducted among 98 Iraqi women between the ages of 18 and 50. Recipients were selected from outpatient clinics and community health centers.

2.1.2 Data Acquisition and Essential Variables

- Anthropometric measurements: The height and weight were documented, and the BMI was determined.
- Vitamin D levels: The serum 25(OH)D concentration was determined using a chemiluminescence immunoassay (CLIA).
- Sun exposure: The participants' average daily amount of sunlight exposure in hours was reported.
- Physical activity: The number of steps taken each day is recorded using a pedometer.

Dietary vitamin D intake: This was assessed using a food frequency questionnaire (FFQ).

2.3.1 Descriptive Analysis

The Pearson correlation was employed to determine the association between BMI, vitamin D levels, and lifestyle factors. One-way ANOVA was used to assess the degree to which vitamin D levels differed by BMI. Multiple linear regression analysis was employed to identify independent predictors of vitamin D content.

3. Results

Table 1. Baseline Information.

Max	Min	Mean \pm SD	Variable
52	31	41.3 \pm 7.1	Age (year)
91	55	73.5 \pm 10.8	Weight (kg)
173	150	159.7 \pm 6.6	Height (cm)
33.9	23.4	28.8 \pm 4.2	BMI (kg/m ²)
37	12	22.5 \pm 7.5	Vitamin D level (ng/ml)
1.5	0.2	0.75 \pm 0.42	Daily sun exposure (hours)
5,999	2,569	3,450 \pm 1,312	Daily steps

The study population consisted of 98 Iraqi women with an average age of 41.3 years (SD \pm 7.1). Participants' weights ranged from 55 to 91 kg, with a mean of 73.5 kg (SD \pm 10.8). BMI values fell within the overweight category on average (28.8 kg/m², SD \pm 4.2). Vitamin D levels varied substantially, with a mean of 22.5 ng/mL (SD \pm 7.5) and a range of 12 to 37 ng/mL, indicating that many participants had suboptimal levels. Sun exposure was limited (mean 0.75 hours/day), with some participants receiving as little as 0.2 hours/day. Daily steps reflected low physical activity levels, with a mean of 3,450 steps/day.

Table 2: Correlation analysis between body mass index and vitamin D levels.

Interpretation	P-value	Correlation coefficient(r)	Mean \pm SD	Variable
Moderate negative correlation	0.001	-0.42	28.8 \pm 4.2	Body mass index (kg/m ²)
Indicates an inverse relationship			22.5 \pm 7.5	Vitamin D level (ng/ml)

The findings show a somewhat negative association ($r = -0.42$) between vitamin D levels and BMI, suggesting that those with higher BMIs often have lower vitamin D levels. The statistical significance of this association is confirmed by the p-value of 0.001, which indicates that the probability of this outcome happening by chance is very low ($p < 0.05$).

- This inverse relationship may be attributed to vitamin D being sequestered in adipose tissue, reducing its bioavailability in individuals with higher body fat percentages.
- These findings are consistent with existing literature that highlights obesity as a risk factor for vitamin D deficiency.

Table 3. Vitamin D levels from daily sun exposure.

Interpretation	P-value	95% confidence interval (CI)	Vitamin D level (mean \pm SD)	Number of participants	Sun exposure group
Significantly lower vitamin D level	0.02	17.5 – 20.9	19.2\pm 6.5	68	Low exposure (< 1hr/day)
Higher vitamin D levels compared to low exposure		25.1 – 30.5	27.8\pm7.1	30	High exposure (> 1hr/day)

Participants who reported ≥ 1 hour/day of sun exposure had significantly higher vitamin D levels (27.8 ng/mL, SD \pm 7.1) compared to those with < 1 hour/day (19.2 ng/mL, SD \pm 6.5). The difference was statistically significant ($p = 0.02$), indicating the importance of adequate sun exposure for maintaining optimal vitamin D levels. The 95% confidence intervals show no overlap, further confirming the significance of the difference.

Table 4. Vitamin D levels by physical activity (steps per day).

p-value	Vitamin D level (mean \pm SD)	Physical activity group
0.03	20.1 \pm 6.8	Low activity (<3000) Steps
	24.7 \pm 7.2	Moderate activity (3000-6000) steps
0.01	28.4 \pm 6.9	High activity (>6000) steps

Vitamin D levels increased progressively with higher physical activity. Participants with > 6,000 steps/day had the highest mean vitamin D levels (28.4 ng/mL, SD \pm 6.9), significantly higher than those with < 3,000 steps/day (20.1 ng/mL, SD \pm 6.8). The difference

was statistically significant ($p = 0.01$), suggesting that increased physical activity is associated with improved vitamin D status.

4. Discussion

This study demonstrates significant associations between BMI, sun exposure, physical activity, and vitamin D levels among 98 Iraqi women. The findings suggest that multiple lifestyle factors collectively influence vitamin D status, with potential implications for public health interventions aimed at reducing vitamin D deficiency.

Higher body weight is linked to lower levels of circulating vitamin D, according to the negative connection between BMI and vitamin D levels ($r = -0.42$, $p = 0.001$). The sequestration of vitamin D in adipose tissue, which lowers its bioavailability, may account for this negative association. As BMI increases, the distribution of vitamin D in fat compartments may limit its release into the circulation. Similar findings have been consistently reported in other populations, supporting the importance of weight management in maintaining adequate vitamin D levels. Addressing overweight and obesity could thus be an essential strategy in correcting vitamin D deficiency [1], [9], [19].

Sun exposure also emerged as a significant factor influencing vitamin D levels. Participants who reported ≥ 1 hour/day of sun exposure had significantly higher vitamin D levels (27.8 ng/mL, $SD \pm 7.1$) compared to those with < 1 hour/day (19.2 ng/mL, $SD \pm 6.5$), with a statistically significant difference ($p = 0.02$) [3], [22], [23]. These findings highlight the critical role of ultraviolet B (UVB) radiation in the endogenous synthesis of vitamin D [2], [10], [11]. Despite living in a region with abundant sunlight, limited daily sun exposure may contribute to suboptimal vitamin D levels. Cultural practices, clothing habits, and time spent indoors may further restrict sun exposure. Encouraging safe and regular sun exposure could be a practical approach to improving vitamin D status [12], [13], [21].

Physical activity levels were also positively associated with vitamin D concentrations. Participants who reported walking $> 6,000$ steps/day had higher vitamin D levels (28.4 ng/mL, $SD \pm 6.9$) compared to those with $< 3,000$ steps/day (20.1 ng/mL, $SD \pm 6.8$), with a significant difference ($p = 0.01$) [14,15]. Increased physical activity may enhance vitamin D levels through greater outdoor exposure to sunlight. Additionally, exercise has been linked to improved metabolic function, potentially influencing the activation and metabolism of vitamin D. Promoting regular physical activity not only improves general health but may also support better vitamin D status [4], [16], [17], [18].

Overall, the findings suggest that maintaining a healthy weight, increasing sun exposure, and engaging in regular physical activity are essential for optimizing vitamin D levels [19], [20]. These modifiable lifestyle factors should be considered in public health interventions to address widespread vitamin D deficiency. Further research with larger sample sizes and longitudinal designs may help clarify causal relationships and provide deeper insights into effective preventive strategies.

5. Conclusion

Higher body mass index is linked to lower levels of serum vitamin D in Iraqi women. Sun exposure and physical activity are significant in determining vitamin D composition. Public health strategies should concentrate on educating people about the importance of vitamin D, promoting outside activities, and ensuring a sufficient amount of dietary intake. Future studies should explore the causal relationships between obesity and the metabolism of vitamin D. This research has significant value in understanding the association between BMI and vitamin D levels, which supports the need for preventative actions to mitigate the deficiency of vitamin D in overweight and obese individuals.

Recommendations

1. Encourage Healthy Lifestyle Habits:

Increasing daily sun exposure and promoting regular physical activity (>6,000 steps/day) can help improve vitamin D levels.

2. Routine Screening and Supplementation:

Regular screening for vitamin D deficiency, especially in individuals with higher BMI, and providing targeted supplementation when needed, is essential.

Ethical considerations

Ethical consideration, approval, and permission to conduct this study were obtained from the Department of Physiology and the College of Medicine, Tikrit University Medical Committee.

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