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Original article

The Relationship between Vitamin D Deficiency Prevalence and Obesity in a Sample from Zawia City, Libya

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ABSTRACT

In this study, vitamin D levels were measured, and the degree of vitamin D deficiency was assessed in relation to age, sex, and body mass index (BMI). A total of 150 individuals, comprising 75 men and 75 women, participated in the study by visiting various medical labs in Zawia City. The levels of vitamin D were determined as follows: Deficient levels of vitamin D: 25(OH)≥ 20 ng/ml; insufficient levels: 21–29 ng/ml; and sufficient levels: 25(OH)D ≥ 30 ng/ml. The findings showed that there was no discernible difference in vitamin D concentrations between age groups or between males and females (P>0.05). However, the deficiency rate was higher in the elderly age group (39.5%) than in the younger and middle-age groups, in the females (29.4%) compared to the males (26.6%). In contrast, a statistically significant difference (P<0.05) was found in serum vitamin D concentration according to body mass index (BMI), with significantly lower concentrations in obese individuals (22.10±1.25 ng/ml) compared to those with normal weight (28.67±1.21 ng/ml). The study concluded that vitamin D levels were lower in the sample, with this decline increasing in females and the elderly. A significant and noticeable decrease in vitamin D levels was also found according to body mass index, with this decline increasing in obese individuals compared to those with normal weight.

Introduction

In general, obesity has a serious impact on public health, reaching global epidemic proportions. It has been found to increase the risk of metabolic syndrome, heart failure, and type 2 diabetes. One of these issues is vitamin D insufficiency [1]. Vitamin D is produced endogenously when solar UV rays (290–315 nm) increase the skin's synthesis of the vitamin, which is then primarily stored in adipose tissue [2]. The propensity of adipose tissue to isolate vitamin D within it, together with the increase in surface area, and consequent difficulties in dispersing it throughout the body. The reasons are for low vitamin D levels in obese individuals. Additionally, when a person gains weight, their fat cells enlarge, causing abnormalities that raise the rate of inflammation and block the active vitamin receptors [3].

Vitamin D is important in the absorption of calcium and phosphorus, immune system T cell activation, and cytokine synthesis. The prevention of autoimmune illnesses, diabetes, and cancer [4]. Compared to individuals who are not obese, vitamin D deficiency prevalence is around 35% and 24%, respectively, among both obese and overweight people [5]. Numerous studies have demonstrated that vitamin D levels decrease in cases of obesity (BMI of ≥30 kg/m^2) by 1.15% for every unit rise in BMI. According to research on animals, fat stores 33% of 25(OH)D, while muscle stores 20% [6]. Because dietary sources of vitamin D are limited, it is often necessary to give supplements to people who suffer from vitamin D deficiency due to a lack of exposure to sunlight or when skin synthesis is reduced. For instance, in obese people and the elderly [4]. The study aims to determine the degree of relationship between vitamin levels and body mass index (obesity) for a sample of individuals attending some medical laboratories in the city of Zawia.

Methods

This study was performed in some laboratories in the city of Zawia, Libya, between 1.5.2025 and 30.7.2025 and included 150 participants (75 males, 75 females), aged 15-56 years, who consented to participate in the study. Measures of height, weight, and BMI were collected as part of the data collection process. Body mass index (BMI) was categorized based on the World Health Organization's recommendation. Five milliliters of blood were extracted from every participant. The samples were centrifuged. Then they were analyzed for 25(OH)D serum using an I-CHROMA device. Vitamin D status was classified into three different categories by the American Endocrine Association: vitamin D deficiency (≤20 ng/ml), vitamin D insufficiency (21–29 ng/ml), and vitamin D sufficiency (≥30 ng/ml) [7]. The data was statistically analyzed using SPSS version 23. Descriptive statistics were conducted. (mean ± SD, frequencies), and the T-test was applied, and one-

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way analysis of variance (ANOVA). It was considered statistically significant when the p-value was less than 0.05.

Results

150 subjects (75 males and 75 females) in a study to assess the connection between body mass index and vitamin D levels. The general mean, standard deviation, minimum, and maximum of all subjects are described in Table 1. The mean age of the entire population was 34.8±11.9 years, with a BMI of 25.0±3.2 kg/m². At the examination, the average weight was 68.4±6.8 kg, and the mean serum vitamin D content was 22.8±9.5 ng/ml.

Table 1. Main characteristics of participants.

Participants characteristic	Mean±*SD*	Minimum	Maximum
BMI (Kg/m²)	25.0±3.2	18.7	34.55
25(OH)D (ng/ml)	22.8±9.5	8	48
Age (years)	34.8±11.9	15	56
Weight (Kg)	68.4±6.8	54	83

Table 2 evaluated vitamin D levels for gender, body mass index (BMI), and age group. In males, 20 (26.6%) were vitamin D deficient, 26 (34.7%) insufficient, and 29 (38.7%) sufficient; in females, the prevalence of deficiency, insufficiency, and sufficiency was 22 (29.4%), 16 (21.3%), and 37 (49.3%), respectively. In addition, among the individuals in the 15–28 age group, 32 (56.1%) had sufficient vitamin D, 14 (24.6%) had insufficient vitamin D, and 11 (19.3%) had deficient vitamin D. Similarly, among the individuals between the ages of 29 and 42, 22 (44%) had sufficient vitamin D, 13 (26%) had insufficient, and 15 (30%) were deficient. Whereas, in the (43-56) years, only 12 (28%) maintained sufficient levels, 14 (32.5%) had insufficient vitamin D levels, and as many as 17 (39.5%) fell into the deficient category. 34 (52.3%) of the normal-weight (18.5-24.9 kg/m²) had sufficient vitamin D levels, 22 (33.9%) had insufficient levels, and only 9 (13.8%) had vitamin D deficiency, according to the body mass index. Vitamin D deficiency, insufficiency, and sufficiency were 14 (24.1%), 14 (24.1%), and 30 (51.8%) for the overweight (25-29.9 kg/m²) group, respectively. By contrast, it was shown that only 4 (14.9%) of the obese individuals (30 kg/m²) had sufficient vitamin D, 5 (18.5%) were insufficient, and 18 (66.6%) were deficient.

Table 2. Distribution of vitamin D levels according to gender, age, and BMI.

Parameters		**Vitamin D level categories, n (%)**		
		Sufficient (≥30ng/ml)	**Insufficient (21-29ng/ml)**	**Deficient (≤20ng/ml)**
Gender	Male	29 (38.7%)	26 (34.7%)	20 (26.6%)
	Female	37 (49.3%)	16 (21.3%)	22 (29.4%)
Age	15-28	32 (56.1%)	14 (24.6%)	11 (19.3%)
	29-42	22 (44%)	13 (26%)	15 (30%)
	43-56	12 (28%)	14 (32.5%)	17 (39.5%)
BMI	Normal 18.5-24.9kg/m²	34 (52.3%)	22 (33.9%)	9 (13.8%)
	Overweight 25-29.9kg/m²	30 (51.8%)	14 (24.1%)	14 (24.1%)
	Obesity≥30kg/m²	4 (14.9%)	5 (18.5%)	18 (66.6%)

The relationship between serum 25(OH)D concentration and gender, age, and categories of BMI is given in (Table 3): No statistically significant difference in vitamin D concentration mean was observed between males and females (P>0.05); the mean 25(OH)D concentration for females was 26.34±1.19 ng/ml, while for males it was slightly higher at 27.72±1.14 ng/ml. Furthermore, the mean vitamin D level in the (15-28) age group was 28.07±1.28 ng/ml, while the mean concentration of vitamin D in the (29-42) years and (43-56) years groups was 27.16±1.49 ng/ml and 25.08±1.53 ng/ml, respectively. Although the (15-28) years displayed a higher mean, the statistical analyses were not significant (P>0.05). Conversely, there was a statistically significant difference in the mean vitamin D concentration between BMI groups (P<0.05); participants with high BMI (obesity ≥30 kg/m²) had a lower mean blood 25(OH)D concentration, at 22.10±1.25 ng/ml. In contrast, the mean values were 28.67±1.21 ng/ml and 26.74±1.37 ng/ml in the normal weight (18.5-24.9 kg/m²) and overweight (25-29.9 kg/m²) populations, respectively.

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Table 3. Serum vitamin D concentration according to sex, age, and body mass index

Parameters		25(OH)D concentration (ng/ml) Mean±Std.Error	p-value
Gender	Male	27.72±1.14	0.945
	Female	26.34±1.19	
Age	15-28	28.07±1.28	0.360
	29-42	27.16±1.49	
	43-56	25.08±1.53	
BMI	Normal 18.5-24.9kg/m²	28.67±1.21	0.041*
	Overweight 25-29.9kg/m²	26.74±1.37	
	Obesity≥30kg/m²	22.10±1.25	

Discussion

In the current study, a random sample of 75 males and 75 females was collected to evaluate the relationship between vitamin D levels and body mass index. The mean (± SD) vitamin D concentration of the participants was 22.8±9.5 ng/ml; the study results showed no significant difference (P>0.05) in the mean vitamin D concentration between males and females. Despite this, males had a slightly higher mean vitamin D concentration than females. 29.4% of females had vitamin D deficiency, while 26.6% of males were also deficient. The outcomes of the study are comparable to those of the study conducted in Dubai, which revealed that there was no statistically significant difference between the sexes. 62% of females and 37% of males had vitamin D insufficiency [8]. A similar study was conducted in Bushehr province, Iran, and the results showed that females had lower levels of vitamin D than males [9]. In addition, a study in Türkiye showed that 24.3% of female participants in the 159 investigations were vitamin D deficient [10]. Furthermore, analyzed information from 5,407 participants over a duration of six years (2018–2024). Among the study population, 77.1% were vitamin D deficient, with females showing a significantly higher prevalence of 62.1% than males (15.0%) [11]. Males exhibited a higher mean of vitamin D compared to females. A statistically significant difference was observed between the two genders. The overall prevalence of deficient vitamin D was found to be 28.5% in males and 63.4% in females of Chandigarh [12]. In contrast to these findings, Eldeeb and Abdelmaksoud [13] found that vitamin D deficiency was significantly higher among males than females. 201 students in all participate in the cross-sectional study (99 males and 102 females). At Kuwait University, male students were found to be more vitamin D deficient (89.9%) than female students (80.4%) [14].

Vitamin D deficiency prevalence between males and females varies in different studies; for example, in the data obtained from a study [15], there was no association between vitamin D level and sex of the participants. Sanghera et al. [16], which examined the relationship between vitamin D and cardiometabolic traits in a population from India, found that serum vitamin D was consistently lower in men compared to women, irrespective of the presence of obesity and type 2 diabetes. Total vitamin D levels were observed to differ significantly by gender, with males having greater levels, 23.90 ± 16.41 ng/ml, than females, 21.24 ± 15.65 ng/ml [17]. Males and females have varying levels of vitamin D. Numerous factors, including sun exposure, diet, sunscreen use, and hormonal effects, could be the origin of these differences.

The participants in the study ranged in age from 15 to 56, with a mean age of 34.8±11.9 years. There was no significant difference in the mean vitamin D concentration between the age groups (P>0.05). However, the older group had the lowest mean vitamin D concentration, 25.08±1.53 ng/ml, with a deficiency rate of 39.5%, and the 29–42 age group had a mean of 27.16±1.49 ng/ml with a deficiency rate of 30%. Conversely, the highest mean concentration, 28.07±1.28 ng/ml, was recorded in the 15-28 age group with a deficiency rate of 19.3%. This suggests that vitamin D deficiency is more common in elderly persons. In line with research carried out in Santiago, Chile, with 1329 participants aged 18 to 89. The prevalence of vitamin D deficiency rises with age, rising from 36.5% under 40 to 48.0% over 60 [18]. A similar relationship was found by Nasri and Ardalan [19], including 259 subjects aged between 18 and 65 years, but with a high prevalence of 25(OH)D deficiency in the elderly. This was similar to the findings of Dik and Kaur [12], who found that both males and females have a higher rate of vitamin D deficiency with increasing age. In contrast to this, a cross-sectional study in healthy subjects from Iran, Total and free 25(OH)D levels were significantly associated with age; their deficiency most frequently occurs in the younger ages between individuals aged 16 to 25 [17]. Furthermore, vitamin D deficiency was more prevalent among younger age groups from Iraq [20]. Older adults generally have low vitamin D levels because of a decrease in 7-dehydrocholesterol in the skin, which is converted by ultraviolet (UV) radiation into previtamin D3 before being metabolised into active vitamin D.

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Vitamin D level is frequently linked to the development of obesity. Based on our study, a statistically significant difference (P<0.05) was observed in the mean serum vitamin D concentration according to body mass index (BMI). The vitamin D deficiency rate was 66.6%, and the mean levels were significantly decreased in the obese group 22.10 ± 1.25 ng/ml. In the overweight group, the mean was 26.74 ± 1.37 ng/ml, with a deficiency rate of 24.1%. Conversely, the concentrations were significantly higher in the normal-weight group, with an average of 28.67 ± 1.21 ng/ml and a deficiency rate of 13.8%. In a related study, it was found that vitamin D deficiency was prevalent in obese participants [21]. In China, a study showed that vitamin D levels with abdominal obesity were lower compared to the counterpart group, suggesting that adiposity phenotypes were strongly linked to serum 25-hydroxyvitamin D levels [22]. 250 adult patients who were overweight or obese participated in a cross-sectional study. Serum concentrations were low in almost half of the obese and overweight individuals [13]. In contrast, Van De Maele et al. [23] found no relationship between variations in body fat mass and serum BMI and changes in serum 25(OH)D. In addition, Mohammed Khalid Mansoor et al. [8] found there is no significant relation between vitamin D and obesity. Similar data were found in a study including subjects older than 65 years. which did not find any correlation between serum levels of 25(OH)D and body fat percentage, weight, or BMI [24]. The accumulation of vitamin D in adipose tissue, limited physical activity, and lack of sun exposure are the reasons the majority of obese people have low vitamin D concentrations.

Conclusion

We conclude that vitamin D levels were similar between age and gender categories. However, older age groups and females were significantly more likely to have vitamin D deficiency. The study additionally determined that vitamin D levels changed significantly based on body mass index (BMI), with individuals with obesity having higher rates of vitamin D deficiency than patients with normal or overweight BMI. Given Libya's sunny climate, the prevalence of vitamin D deficiency in this sample highlights the necessity of prevention and treatment initiatives.

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Conflicts of Interest

The authors declare no conflicts of interest.

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