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SHORT COMMUNICATION article

Body mass index and vitamin D in Libyan women

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Abstract: Vitamin D deficiency is a common health problem among Libyan women. Age, gender, inadequate exposure to sunlight, and obesity are common risk factors for this issue. In this study, we randomly examined 40 Libyan women (age: 17.58±10.45, mean±SD, range: 15 years to 65 years). Blood samples were taken from each participant and directly centrifuged and processed on Cobas 411 Automatic Electrochemil-uminescence Immunoassay Analyzer. Vitamin D levels were measured in ng/ml and the mean serum value was calculated for the total. Body weight and height for each participant were taken to calculate the body mass index. The findings revealed that all participants are suffering from vitamin D deficiency with less than 30 ng/ml serum levels. Female participants aged between 55 and 65 years tend to have a less degree of vitamin D deficiency as compared to the other age subgroups with a mean level of 27 ng/ml of vitamin D. This study revealed the association between vitamin D levels and obesity as measured by body mass index, in contrast, it found that overweight participants have higher vitamin D levels as compared to other groups of body mass index.

Introduction

Vitamin D is an essential nutrient that can be produced in the body [1]. Vitamin D is a lipid-soluble vitamin that is vital for the maintenance of bone and muscle health by promoting the absorption and metabolism of phosphate and calcium [2]. Most of the vitamin D in the body comes from sunlight. There are some dietary sources of vitamin D, it is found in oily fish and in smaller amounts in red meat and egg yolk. Some foods contain cholecalciferol (vitamin D_3) and ergocalciferol (vitamin D_2), which are biologically inactive, but when they are eaten and absorbed, they are transported to the liver and follow the same metabolic pathway as vitamin D_3 from sunlight [3]. Several high-risk groups for vitamin D deficiency have been identified including individuals who avoid sun exposure, have darkly pigmented skin, are obese and suffer from chronic kidney disease [4, 5]. Adipose tissue is a major repository of vitamin D_3 in the body [6]. Thus, it has also been suggested that the metabolic clearance of vitamin D_3 may increase in obesity, possibly with enhanced uptake by adipose tissue [5, 7, 8]. The adipose tissue sequestration is linked to obesity-associated vitamin D insufficiency which is most likely due to the decreased bioavailability of vitamin D_3 from cutaneous and dietary sources because of its deposition in body fat compartments [9]. Recently, by using imaging mass spectrometry techniques, Malmberg et al. [10] demonstrated that vitamin D_3 and its metabolites were in adipocyte lipid droplets. Heaney et al. [11] have found that 17.0% of orally administered vitamin D_3 dose was stored in adipose tissue and the rest was consumed or metabolized. However, clinical trials investigating the effects of vitamin D supplementation on body weight have not provided consistent data on the possible

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beneficial effects of vitamin D on weight loss [12]. Obesity is defined as a body mass index (BMI) of 30.0 kg/m^2 or more [13]. Obesity is a pandemic, affecting substantial numbers in most developed nations. In just six years from 2010 to 2016, the estimated prevalence of overweight increased by 33.0% in Sub-Saharan Africa, 43.0% in Western Pacific, and 48.0% in South-East Asia [14]. BMI is used to screen for weight categories and is also an internationally accepted measure to assess body fatness, and is widely accepted as a reliable indicator of excess body weight [15]. There is a strong inverse association of serum vitamin D with BMI, and this inverse association with BMI remained consistently significant when analyzed separately [16]. This study aimed to evaluate the relationship between serum vitamin D and BMI in Libyan women.

Materials and methods

Study design: This study was performed on forty Libyan female participants at the beginning of 2024. Data were mostly collected from workers at the National Center for Diabetes and Endocrinology that were from 22 subjects, while 13 subjects were collected from Zahrat Alnarges Laboratory in Zweta Street and five subjects were collected from Almokhtabar Alteppi Alhadeeth Laboratory in Alhadba Alkhadra. The collected data include the age, weight, height, and serum vitamin D levels.

Ethical approval: This study was conducted according to the guidelines laid down in the Declaration of Helsinki. All the participants were asked to complete a predesigned face-to-face questionnaire that included most of the data needed for this study such as age, weight, and height. For this kind of data analysis, formal consent is not required.

Vitamin D assay: The recommended test of the total level of vitamin D in the body is by determining the level of 25-hydroxy vitamin D in the blood [17]. Cobas E411 Analyzer from Roche Company was used to process the samples for the vitamin D test. A blood sample (5 ml) was taken from each participant in a vacutainer tube under a sterile condition. Then, it was centrifuged to separate the serum and directly processed on Cobas 411 Automatic Electrochemiluminescence Immunoassay Analyzer (Roche Diagnostics, Mannheim, Germany). All tests were performed in the laboratory using an available ELISA kit 25-OH vitamin D serum quantification provided by Roche Diagnostics Co., Ltd., Germany, following the American Society for Testing and Materials communication protocol (ASTM communication protocol).

Statistical analysis: Data were transformed into a Microsoft Excel spreadsheet. Mean and standard deviation were calculated and then analyzed statistically by MedCalc Software for Windows, version 22.023 (MedCalc Software, Ostend, Belgium). The significance of the difference between the means of data was statistically analyzed by a two-tailed Student t-test. Those with a $P<0.05$ were considered statistically significant [18].

Results

This study contains several adult female Libyan subjects (n=40) selected randomly from participants who lived in Tripoli City to assess vitamin D and body weights. Thus, in **Table 1**, the age of the participants was frequently between 15 years and 35 years and represents 55.0% of the total participants. All the female subjects have vitamin D less than the normal values with serum vitamin D levels below the normal (<30.0 ng/ml). The mean serum 25-hydroxyvitamin D level of the older subjects belonging to the age group of 46 years and 65 years (25.5±15.2 ng/ml, n=12). There are significant differences among the groups ranging from $P<0.05$ and $P<0.001$ (**Table 1**). The relationship between the length of the participant and the level of serum vitamin D is shown in **Table 2**. Thus, here, the nearly normal value of vitamin D is correlating to the 149-158 cm height range. A highly significant difference in vitamin D when the 149-158 cm group (n=15) compared with the height group of 159-168 cm by ** $P<0.01$ was observed.

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Table 1: Serum vitamin D levels and the age of the female Libyan participants

Age range (years)	Participants (n)	Mean vitamin D (ng/ml)	Standard deviation
15-25	10	08.2	3.85
26-35	12	14.6 ^{NS}	10.0
36-45	06	15.1 *	08.2
46-55	06	22.5 ***	05.5
56-65	06	27.5 *	24.7

NS: no statistical significance between the vitamin D of 15-25 years and the vitamin D of 26-35 years,
Significant when 15-25 years compared with the other age groups by * P<0.05 and *** P<0.001

Table 2: Serum vitamin D levels and the height of the body of the female Libyan participants

Height range (cm)	Participants (n)	Mean of vitamin D (ng/ml)	Standard deviation
149-158	15	28.2	25.4
159-168	21	12.2 **	8.5
169-178	04	13.25 ^{NS}	7.3

NS: no statistical significance between the vitamin D of 149-158 cm and the vitamin D of 169-178 cm,
Significant when the 149-158 cm compared with the height group of 159-168 cm by ** P<0.01

This study examined the relationship between the weight of the participant and serum vitamin D levels as shown in **Table 3**. Thus, all the data were below the normal values except one group showed a level of vitamin D which is nearest to the normal for the weight range of 61.0 Kg-70.0 Kg weighted participants (30.0 ng/ml, n=9). However, no statistically significant difference was found among the groups by Student t-test. It also calculated the BMI for each participant included and examined its relationship with serum vitamin D levels. Thus, as it appears in **Table 4**, all the participants who have normal BMI have lower serum vitamin D levels (8.8 ng/ml, n=17), while the overweight participants having BMI of 25-30 Kg/m^2 were having serum vitamin D levels burden to normal range (28.7 ng/ml, n=15).

Table 3: Body weights of the female Libyan participants and vitamin D levels

Weight range (Kg)	Participants (n)	Mean of vitamin D (ng/ml)	Standard deviation
51-60	12	16.6	12.6
61-70	09	30.8 ^{NS}	28.1
71-80	12	15.0 ^{NS}	9.1
81-90	02	22 ^{NS}	2.8
91-100	03	18.6 ^{NS}	10.2
101-110	00	0.0	0.0
111-120	02	21.0 ^{NS}	12.7

NS: no statistical significance between the vitamin D of the 51-60 Kg
and the vitamin D of the other weight groups

Table 4: Serum vitamin D and BMI of the female Libyan participants

BMI (Kg/m^2)	Participants (n)	Average vitamin D (ng/ml)	Standard deviation
Underweight (17-18)	0.0	0.0	0.0
Normal weight (19-24)	17	8.8	5.1
Overweight (25-29.9)	15	28.7 *	24.0
Obesity 1 (30-34.9)	03	18.6 *	7.7
Obesity 2 (≥35)	05	19.6 *	8.2

* Significant difference by P<0.05 between the BMI of 19-24 kg/m^2 and each BMI group, Student t-test

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Discussion

Vitamin D deficiency is a global public health issue. About one billion people worldwide have vitamin D deficiency, while 50.0% of the population has vitamin D insufficiency [19]. The prevalence of patients with vitamin D deficiency is highest in the elderly and obese patients [20, 21]. The reasons for the widespread vitamin D deficiency are not completely understood, but researchers believe that lifestyle changes may play an important role. We found that the age groups (56-65) years old had the nearest value to normal (mean of 27.5 ng/ml). Most studies indicate that males and younger adults had a higher prevalence of vitamin D deficiency compared to females and older participants [22, 23]. In this small-size study, which was performed in Tripoli-Libya, we found that overweight people a BMI of more than 25 Kg/m^2) represent 57.5% of the participants. In contrast to many studies that reported that there is a strong inverse relationship between obesity and serum vitamin D, we found that the overweight participant had a vitamin D serum value of (28.7 ng/ml) which is very near to the normal value (30-100 ng/ml), that may be related to the physical activity they do or to the time of sun exposure they have since we have a sunny day most of the year [24]. according to our results, it seems that the majority of Libyan women are suffering from vitamin D deficiency however women aged between 40 and 65 years old tend to have a less degree of deficiency as compared to the other age groups. This was matched with other studies regarding age relation with vitamin D. Regarding BMI, in contrast to many studies we found that the higher vitamin D values but still under normal level were for the overweight participants. However, the small number of participants does not give us conclusive results. Furthermore, this variation in results may be due to different lifestyles, variations in physical activity, and when the last regimen of vitamin D they have. Therefore, more research needs to be done on a large number of people.

Conclusion: The majority of Libyan women are suffering from vitamin D deficiency, however, women aged more than 40 years old tend to have a lesser degree of deficiency. Regarding body mass index, the higher vitamin D values but still under normal levels were for the overweight participants.

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Ethical issues: Including plagiarism, informed consent, data fabrication or falsification, and double publication or submission were completely observed by the authors.
Data availability statement: The raw data that support the findings of this article are available from the corresponding author upon reasonable request.
Author declarations: The authors confirm that all relevant ethical guidelines have been followed and any necessary IRB and/or ethics committee approvals have been obtained.