Evaluation of Vitamin D status and the Age and Gender Associated Risk Factors in Libyan Population

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Abstract

Background: Vitamin D deficiency is an international and national public health concern.

Objectives: This study's aims were to evaluate the status of vitamin D and the correlation between vitamin D deficiency with age and gender among Libyan population in Tripoli, Libya.

Materials and Methods: A retrospective study was conducted with 2413 Libyan males and females aged 7 months–94 years attended Al-Tafani center for medical analyses from October, 2018 to September, 2022 in Tripoli. The circulating 25(OH) D levels were measured using Chemiluminescence Immunoassay (CLIA) System.

Results: The vitamin D level distribution in the Libyan population showed significant differences between the vitamin D deficiency, insufficiency and sufficiency groups. The distribution of vitamin D levels in females and males groups reported significant differences between the vitamin D deficiency, insufficiency and sufficiency groups. Moreover, the vitamin D level was higher in the males group than the female group. High vitamin D levels in the 8^{th} and 9^{th}, and low in the 2^{nd} and 3^{rd} decade groups were observed when compared with the all decades groups. Vitamin D level in females was high in the 8^{th} and 9^{th}, and low in the 2^{nd} decade female groups when compared with the all decades female groups. Comparison of vitamin D levels with all decade's groups did not show significant differences in the male groups.

Conclusion: The 25(OH) D level was significantly higher in the male than the female participants involved in this study. Although the younger female participants had lower vitamin D level compared with the older participants, no significant difference was reported between the older and younger males. However, the distribution of 25(OH) D level was insufficient in most groups.

Keywords: Vitamin D 25(OH) D, Gender, Age, Libyan population

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Introduction

1,25-dihydroxy vitamin D3 (cholecalciferol) is a fat-soluble vitamin and an essential micronutrient that has major implications for human health. There are two sources of vitamin D; cholecalciferol (vitamin D3) which is produced in the cutaneous tissue of animals when exposed to UV-β radiation, and ergocalciferol (vitamin D2) which is synthesized in plants (Deluca and Holick, 1974). Both forms of vitamin D are transported to the liver bound to vitamin D-binding protein (DBP) and metabolized to the predominant form of vitamin D in plasma (calcidiol or 25-hydroxycholcalciferol) through an enzymatic process involving calciol-25-hydroxylase enzyme (Chun *et al.*, 2014; Bouillon *et al.*, 2020). The serum level of 25(OH) D is measured to determine the adequacy of vitamin D status. In the kidney, 25(OH)D is hydroxylated to 1,25-dihydroxyvitamin D, (calcitriol or 1,25-hydroxycholcalciferol)which is the only biologically active form of vitamin D (also known as active vitamin D (Deluca and Holick, 1974; Deluca, 1986).

Vitamin D is well-known for its important role in bone and mineral metabolism (Holick, 1996). In the last few decades, the interest to investigate the function of vitamin D has been renewed because emerging data suggest that its benefits extend beyond healthy bones. In this context, vitamin D has a wide range of non-classical actions of anti-proliferative effects through multiple mechanisms including the induction of cell cycle arrest, apoptosis and differentiation *in vitro* and *in vivo* in a variety of cancer cell types including prostate, breast, colon, skin and leukemic cells (Holick, 2003, 2007).

In the last decades, vitamin D deficiency was considered as a pandemic, widespread and a major health problem globally (Mithal *et al.*, 2009; Van Der Meer *et al.*, 2011). The deficiency of vitamin D was previously identified by the presence of bone disease, either rickets in infancy or osteomalacia in adults. Although there is no consensus on optimal levels of 25-hydroxyvitamin D as measured in serum, vitamin D deficiency is defined by most experts as a 25-hydroxyvitamin D level below 10 ng per milliliter (25 nmol per liter) (Malabanan *et al.*, 1998; Bischoff-Ferrari *et al.*, 2006; Holick, 2006). A cutoff value of 30 ng/ml (75 nmol per liter) is sometimes used for optimal 25-hydroxyvitamin D level (Holick, 2006).

The variation of vitamin D levels was related to the differences of physical factors including clothing, sunscreens, and glass shielding which may reduce or completely eliminate the production of vitamin D3 in the skin (Holick, 1994). Moreover, biological factors may inhibit

cutaneous vitamin D synthesis and bioavailability include skin colour, medication use, body fat content, fat malabsorption, gender and age (MacLaughlin and Holick, 1985; Wortsman *et al.*, 2000; Koutkia *et al.*, 2001; Pascussi *et al.*, 2005; Sanghera *et al.*, 2017). In addition, there are common pre-analytical factors may affect the measurement of vitamin D in clinical laboratories (Alnagar, 2018).

Several studies investigated the levels of vitamin D in Libyan population (Omar *et al.*, 2017, 2018; Atia and Arhoma, 2022; Msalati *et al.*, 2022). This study aimed to assess the vitamin D status in Libyan population and the effect of gender and age as risk factors.

Materials and methods

Study population

Data analyzed in this study were collected from the Altafani laboratory records from a population of 2413 participants, age 7months-94years, who visited the laboratory in the period between October, 2018 and September, 2022.

25(OH) D status assessment:

The analysis for serum 25 (OH) D was done by Chemiluminescence Immunoassay (CLIA) System (SNIBE Maglumi 800). The 25(OH) D status was analyzed according to the reference values:

i. Deficient (25(OH) D level >10 ng/ml).
ii. Insufficient (25(OH) D level between 10 and 30 ng/ml).
iii. Sufficient (25(OH) D level >30 to 100 ng/ml).

Statistical analysis

Data were analyzed using Graph Pad Prism statistical software (version 6.0b; Graph Pad Software Inc., La Jolla, CA, USA). Results are expressed as mean ± SEM and the analysis of data between groups was performed using Mann Whitney test and statistical significance between groups was accepted at $p<0.05$.

Results

This study included 2413 participants with 1559 females (64.6%) and 853 males (35.4%). The age of the participants involved in this study ranged from 7 months to 94 years, and was grouped in decades analyzed to both genders with the level of 25(OH)D as shown in Table 1. The mean ± SEM of vitamin D value of females was 21.38±0.38 and males was 22.55±0.52 as shown in Table 1.

Vitamin D level distribution showed significant differences between the vitamin D deficiency, insufficiency and sufficiency groups (Figure, 1).

Table 1: Number and percentage of the participants and their Mean±SEM of vitamin D

Parameter	Number	Percentage	Mean±SEM of 25(OH)D
Distribution of vitamin D	2412	100%	
Deficiency	370	15.33%	5.34±0.17
Insufficiency	1558	64.59%	19.03±0.17
Sufficiency	484	20.06%	43.25±0.81
Distribution of vitamin D in females	1559	100%	
Deficiency	254	16.29%	5.35±0.22
Insufficiency	1002	62.27%	18.85±0.20
Sufficiency	303	19.34%	43.18±1.08
Distribution of vitamin D in males	853	100%	
Deficiency	116	13.59%	5.32±0.24
Insufficiency	556	65.18%	19.36±0.31
Sufficiency	181	21.21%	43.38±1.23
Gender	2412	100%	
Females	1559	64.6%	21.38±0.38
Males	853	35.4%	22.55±0.52
Age of participants (year)	2413	100%	
1st decade	98	4.06%	21.70±1.35
2nd decade	180	7.45%	20.61±1.33
3rd decade	478	19.80%	20.22±0.62
4th decade	547	22.66%	21.97±0.70
5th decade	499	20.67%	21.90±0.56
6th decade	318	13.17%	22.03±0.81
7th decade	150	6.21%	21.65±1.00
8th decade	90	3.72%	27.48±2.91
9th decade	44	1.82	27.25±2.29
10th decade	7	0.29%	21.44±3.39
Age of female participants (year)	1558	100%	
1st decade	49	3.14%	18.80±1.28
2nd decade	124	7.95%	20.25±1.75
Age of Male participants (year)	853	100%	
1st decade	49	5.74%	24.59±2.31
2nd decade	56	6.56%	21.41±1.83

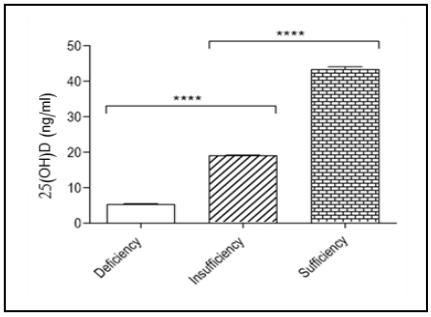

Figure (1). Distribution of vitamin D.

Vitamin D level showed significant differences between the vitamin D deficiency, insufficiency and sufficiency groups. Values were analyzed by Mann Whitney test and columns represents the mean ± SEM of 370, 1558 and 484 vitamin D deficient, insufficient and sufficient participants respectively with **** representing P < 0.0001 respectively.

The distribution of vitamin D levels in females and males groups reported significant differences between the vitamin D deficiency, insufficiency and sufficiency (Figures, 2 and 3 respectively).

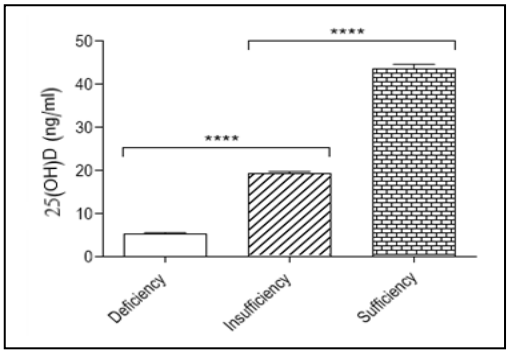

Figure (2). Distribution of vitamin D in females.

Vitamin D level showed significant differences between the vitamin D deficiency, insufficiency and sufficiency groups. Values were analyzed by Mann Whitney test and columns represents the mean ± SEM of 254, 1002 and 303 vitamin D deficient, insufficient and sufficient participants respectively with **** representing P < 0.0001 respectively.

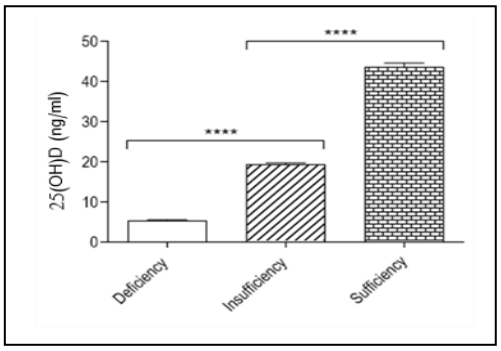

Figure (3). Distribution of vitamin D in males.

Vitamin D level showed significant differences between the vitamin D deficiency, insufficiency and sufficiency groups. Values were analyzed by Mann Whitney test and columns represents the mean ± SEM of 116, 556 and 181 vitamin D deficient, insufficient and sufficient participants respectively with **** representing P < 0.0001 respectively.

The association of gender with vitamin D showed that the vitamin D level was higher in the males group than the female group (Figure, 4).

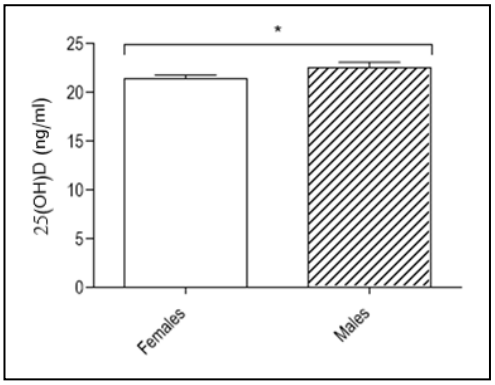

Figure (4). Association of gender with vitamin D.

Vitamin D level was higher in the males group than the female group. Values were analyzed by Mann Whitney test and columns represents the mean ± SEM of 1559 female and 853 male with * representing P < 0.05.

In regard to age, vitamin D level was high in the 8th and 9th, and low in the 2nd and 3rd decade groups when compared with the all decades groups (Figure, 5).

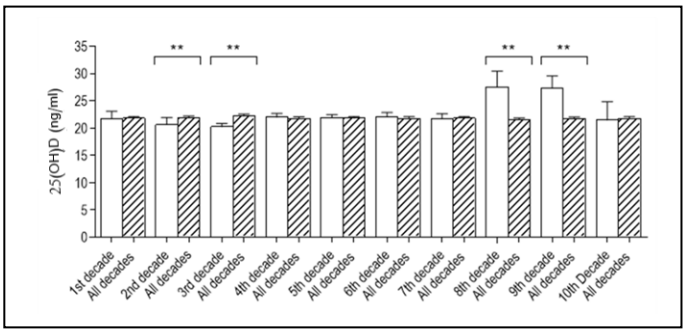

Figure (5). Association of age with vitamin D.

Vitamin D level was high in the 8th and 9th, and low in the 2nd and 3rd decade groups when compared with the all decades groups. Values were analyzed by Mann Whitney test and columns represents the mean ± SEM of 98, 180, 478, 547, 499, 318, 150, 90, 44, and 7 participants in the 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th, and 10th decades respectively with ** representing P < 0.01.

The association of age with vitamin D in females revealed that vitamin D level was high in the 8th and 9th, and low in the 2nd decade female groups when compared with the all decades female groups (Figure, 6).

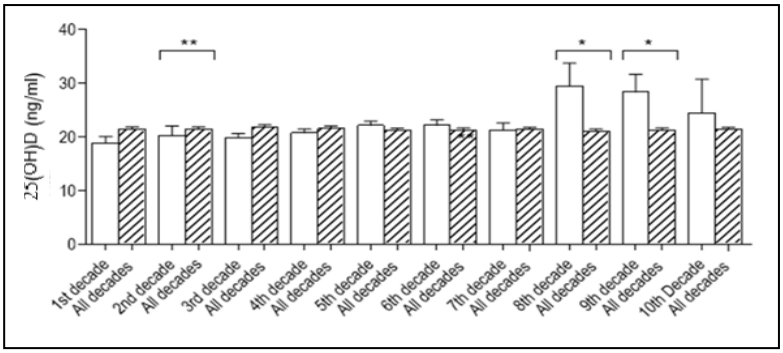

Figure (6). Association of age with vitamin D in females.

Vitamin D level was high in the 8th and 9th, and low in the 2nd decade female groups when compared with the all decades female groups. Values were analyzed by Mann Whitney test and columns represents the mean ± SEM of 49, 124, 340, 344, 302, 222, 97, 56, 21 and 3 females in the 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th, and 10th decades respectively with * and** representing P < 0.05 and 0.01, respectively.

To elucidate the association of age with vitamin D in males, the comparison of vitamin D levels with the all decade's groups did not show significant differences in the male groups (Figure, 7).

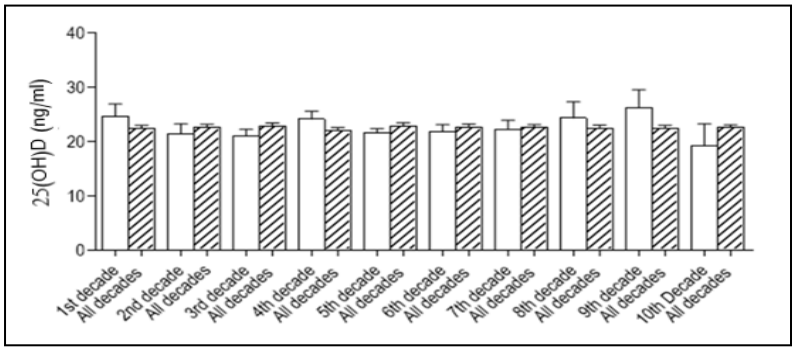

Figure (7). Association of age with vitamin D in males.

Vitamin D levels did not show significant differences in the male groups when compared with the all decade's groups. Values were analyzed by Mann Whitney test and columns represents the mean ± SEM of 49, 56, 138, 203, 197, 96, 53, 34, 23 and 4 males in the 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th, and 10th decades respectively with ** representing P < 0.01.

Discussion

Hypovitaminosis of vitamin D is an established international public health issue (Van Der Meer *et al.*, 2011; AlQuaiz *et al.*, 2018). More recently, this health concern is also reported in several national studies among Libyans (Omar *et al.*, 2017, 2018; Faid *et al.*, 2018; Atia and Arhoma, 2022; Msalati *et al.*, 2022).

In this study, although the percentage of female participants was (64.6%) which represents about two folds than that of male participants (35.4%), the vitamin D level was higher in the male than the female group with $P < 0.05$. This result was in accordance with several national and international findings (Verdoia *et al.*, 2015; Omar *et al.*, 2017; AlQuaiz *et al.*, 2018; Faid *et al.*, 2018; Atia and Arhoma, 2022; Msalati *et al.*, 2022). Libya is a sunny country most of the year where the sun exposure and levels of vitamin D are expected to be adequate, but most Libyan studies reported a low level of vitamin D in Libyan females than males. Most of these studies attributed this finding to different cultural factors including the negative attitude toward sun exposure linked to cosmetic concerns, live indoors, cultural dresses and nutritional habits (Faid *et al.*, 2018; Omar *et al.*, 2018; Atia and Arhoma, 2022; Msalati *et al.*, 2022).

The older participants in this study also reported higher vitamin D level compared with the younger participants. In addition, the older female participants in this study had higher vitamin D level compared with the younger female participants. In contrast to the female groups, there was no association of age with 25(OH)D levels in males compared with all decades groups. This finding may be attributed to that the older people uses frequent vitamin D supplements and are exposed to the sun more frequent compared with the younger females who avoid the exposure to the sun for cosmetic purposes (AlQuaiz *et al.*, 2018; Omar *et al.*, 2018).

The vitamin D level distribution among all groups in the current study showed that the level of vitamin D was insufficient in the majority of participants. This observation was also reported when the distribution of vitamin D levels were compared in female and male groups with.

Conclusion

In conclusion, our study reported that the circulating concentrations of 25(OH)D was significantly higher in the male than the female group participants. Moreover, the older participants reported higher vitamin D level compared with the younger participants. The older female participants in this study had higher vitamin D level compared with the younger female participants. Overall, the distribution of 25(OH)D level was insufficient in the majority of Libyan population.

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