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Assessment of vitamin D levels among Saudi population in Hotat Bani Tammim, South of Riyadh

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ABSTRACT
In recent days, it is observed that, the prevalence of vitamin D deficiency not only in the kingdom of Saudi Arabia but also in Golf and some other Arabic countries is very high by reachingto 80% in adults and more than 60% in children. Therefore, the objective of the present study was to determine serum vitamin D (25(OH)D) concentrations in healthy Saudi Arabian peoples who reside in HotatBaniTamim, South of Riyadh- Saudi Arabia. The results revealed that out of total 96 persons accepted to participate were 48 females and 48 males. At the beginning of the study; the average vitamin D level in serum was found 11.48 ng/ml for females and18.49 ng/ml for males whereas glucose, urea and creatinine were 6.34 mmole/l, 4.42 mmole/l and 62.97 µmole/l respectively. After treatment with vitamin D tablet orally every day by participants for three months, the vitamin D level in serum was measured again and the results showed that the average vitamin D levels were improved and reached to 34.01 ± 4.41in females while 35.40 ± 3.51 ng/ml, in males.Also decreased levels of glucose, creatinine and urea were observed after vitamin D supplementation. Thus, this study shows that the residents of HotatBaniTamim were suffering from vitamin D deficiency which was improved by exogenous vitamin D supplementation.
Key words: Vitamin D deficiency, glucose, creatinine, urea, HotatBaniTamim.

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INTRODUCTION

Vitamin D, the sunshine vitamin, plays a physiological role in maintaining the extracellular calcium levels in the body. Extracellular calcium is essential for the normal function of many metabolic processes and neuromuscular activities. Vitamin D influences calcium levels by controlling its absorption from the intestine, through direct effect on bone and also through its effect on parathyroid hormone secretion [1].
Vitamin D deficiency can lead to many health-related problems including rickets, osteomalacia, and osteoporosis that can lead to pathological bone fracture and disability [2]. Its deficiency is also related to hypertension, obesity, insulin resistance and glucose intolerance [3].
The clinical presentation of vitamin D deficiency occurs when the levels are <25 ng/mL, which can cause bone pain, fracture, and muscle weakness. Vitamin D inadequacy can be due to many factorssuch as; age (80 years), race (nonwhite), body mass index (BMI)>30 kg/m^2, limited exercises, inadequate sun exposure, poor diet, drugs that affect vitamin D metabolism and diseases that interfere with its absorption [1]. Vitamin D is an essential fat-soluble vitamin that is required for regulation of calcium metabolismand to maintain good health [4]. Besides the dietary resources, it can also be synthesized in the human skin by exposure to ultraviolet B (UVB) radiation by converting 7-dehydrocholesterol to pre-vitamin D[5].
Known factors that affect cutaneous production of vitamin D_3 include latitude, season, time of day, air pollution, cloud cover, glass shielding, melanin content of the skin, use of sun-blockers, age and the extent of clothing covering the body [6].

Many healthy Saudi adults suffer from severe vitamin D deficiency[7]. Vitamin D deficiency may be detrimental to health; as contemporary evidence suggests health consequences for those with insufficient levels of serum vitamin D as compared to those with sufficient levels[8].An insufficient titer of serum vitamin D has been linked with lower endurance capacity and muscle strength.Saudi Arabia is sunny most of the year, hence the level of vitamin D is expected to be adequate but several studies reported the deficiency of vitamin D in Saudi population [9].

Moreover, the Saudi lifestyle typically involves maximum amounts of time spent in front of a computer, smartphones, watching television or busy in long drives, which can reduce the frequency of outdoor activities that results in their limited sun exposure[10].The major source of vitamin D is the casual sun exposure and to a lesser extent, dietary intake. Even so, the natural diets that most humans consume contain little amounts of vitamin D, with the exception of oily fish, cod liver oil and sun exposed mushrooms[11].

A recent study amongst Saudi locals and expatriates revealed higher vitamin D levels during winter months than in the summer[12]. The reason for this unexpected trend in the summer was the avoidance of sunlight to prevent from scorching heat effects on skin and health. In addition, girls are more vitamin D deficient as they are exposed to little or no sunlight due to the covering of their bodies with dark veils (Abbayia) for cultural and religious reasons [9].Therefore, this study was planned to identify the vitamin D status in the both male and female adult of HotatBeniTammim, South of Riyadh.

MATERIAL AND METHODS

Subjects and data collection

This study was conducted in 2013-2014 in two seasons; the summer (May, June and July) and winter (November, December and January). This study was carried out at HotatBeniTammim province, South of Riyadh, Saudi Arabia.A total of 96 apparently healthy Saudi volunteers were recruited from randomly selected general hospital within HotatBeniTammim, South Riyadh and consisted of 48males (age from10to60 years) and 48females(age from10 to 60 years). Written informed consents from the participants were obtained prior to inclusion. Subjects with chronic conditions such as osteoporosis, type 2 diabetes mellitus, renal, liver, and gastrointestinal diseases, as well as those on any form of drug treatment with possible effect on bone metabolism (e.g. corticosteroids, anticonvulsants, and/or thyroid hormones) were excluded from the study.

A pre-designed and approved questionnaire, which included information on socio-demographics, polar questions (yes or no questions) with regards to knowledge about vitamin D and vitamin D-associated diseases were administered to all subjects along with multiple choice questions about sunshine exposure and duration.

All participants were given a questionnaire developed in Arabic language by the investigators and pretested and coded before the actual field work. The participants were also given a covering letter that explained the objectives of the study and included information (telephone number and emails) of the investigators for any inquires. The questionnaire included questions on socio-demographic state, anthropometric measurements, knowledge about vitamin D and Vitamin D deficiency, skin color, dietary intake, sun exposure, smoking, and physical activity.

Vitamin D status analysis

Blood samples were collected from the subjects in the 3 different time periods throughout the study, which includes part of the summer and winter. Specimens were collected during the day, from 09:00 o'clock to 12:00 noon. In all samples, the serum was immediately separated and the samples were protected from light and stored at -70 °C. The samples were then sent in ice to laboratory (at Prince SattamBin Abdullaziz University Hospital, Al-Kharj, Saudi Arabia). Serum 25(OH)D was measured using COBAS e-411 automated analyzer (Roche Diagnostics, Indianapolis, IN, USA) in a DEQAS (Vitamin D External Quality Assessment Scheme).Glucose, urea andcreatinine, were determined by Bio-system kits (Barcelona, Spain) purchased from local market.

The cutoff points for vitamin D levels, namely, ≤11ng/ml for deficiency, >11.1-15ng/ml for insufficiency, >15.1-20 ng/ml for sufficiency and > 20.1 for normal,were used in the analysis of the data[13].

Statistical analysis

Data was analyzed using SPSS version 16.0 (SPSS, Chicago, IL, USA). Frequencies were presented as percentages (%) and continuous variables were presented as mean ± standard deviation. Chi-Square test was applied to compare frequencies and independent Student*t-test* for normally distributed continuous variables. Significance was set at p-value < 0.05.

RESULTS

The biochemical parameters in this study were summarized in Table 1. At the beginning of the study, the mean ± SD of serum 25(OH)D was 11.48±6.30ng/ml for females and 18.49±8.30 ng/ml for males. The levels of vitamin D in serum for females were characterized as the vitamin D deficiency group, while the levels in males were in the relative insufficiency group.The prevalence of vitamin D deficiency was significantly greater in the female group with 42.6%, as compared to only 7.55% among males in these groups ($p<0.05$). The least levels of vitamin D were found in the group of 20-30 years (13.60 ± 5.22) before taking vitamin D while this value was improved and reached to (34.22 ±10.53) after the participants received vitamin D for three months (Table 2). The glucose and urea levels for females (Glucose 6.36± 3.71; Urea 4.42± 1.37) were found comparable to the levels in males (Glucose 6.32± 2.98; Urea 4.42± 1.28) ($p > 0.05$).Similar to vitamin D readings while the levels of creatinine were found higher in females than males with resultant values of 61.52± 15.98 and 4.42±11.45 respectively (Table 1).

Table (1): Total average of different biochemical parameters for participants according to gender

Parameter	Gender	Concentration
Vitamin D (ng/ml) before dose	F	11.48±6.30
	M	18.49±8.30
Vitamin D (ng/ml) after dose	F	34.01±11.41
	M	35.40±11.51
Glucose (mmole/l)	F	6.36± 3.71
	M	6.32± 2.98
Urea (mmole/l)	F	4.42± 1.37
	M	4.42± 1.28
Creatinine (µmole/l)	F	61.52± 15.98
	M	4.42±11.45
Body Mass (BMI)	F	27.45±5.06
	M	27.19±4.98

Prevalence of various vitamin D levelssummarized by age of the participantsare shown in Table 2. The mean (SD) of vitamin D levels in serum for participants whose age ranged from 10-20, 20-30, 30-50 and above 50 years were 13.77±6.09, 13.60±5.22, 15.89±10.07and 16.55±9.38 ng/ml respectively while these ranges raised to 31.10±10.48, 34.22±10.53, 36.37±12.07 and 35.28±12.50 ng/ml respectively after taking vitamin D supplement for three months. The results in Table 2 indicated that the vitamin D levels in serum of all age groups were improved after receiving the vitamin D supplement for three months regularly.

Table (2): Mean serum vitamin D concentration of participants before dose according to age

	No. of Participants	Vitamin D concentration (ng/ml) before dose	Vitamin D concentration (ng/ml) after vitamin D dose
From 10-20 years	15	13.77±6.09	31.10±10.48
From 20-30 years	29	13.60±5.22	34.22±10.53
From 30-50 years	35	15.89±10.07	36.37±12.07
From 50 -60 years	17	16.55±9.38	35.28±12.50

The results tabulated in Table 3, 4 and 5 indicate that the high levels of serum glucose, urea and creatinine were found high only in group above 50 years of age (7.97± 4.57), (4.55±1.39mmole/l) and (66.12±19.08µmole/l), respectively.

Table (3): Determination of glucose concentration (mmole/l) among participants according to age

	No. of Participants	glucose concentration
From 10-20 years	15	6.21±4.80
From 20-30 years	29	6.00±2.64
From 30-50 years	35	5.88±2.15
From 50 -60 years	17	7.97±4.57

Table (4): Determination of urea (mmole/l) among participants according to age

	No. of Participants	Urea concentration
From 10-20 years	15	3.99±1.24
From 20-30 years	29	4.44±1.49
From 30-50 years	35	4.55±1.39
From 50 -60 years	17	4.48±0.89

Table (5): Determination of creatinine (µmole/l) among participants according to age

	No. of Participants	Creatinine concentration
From 10-20 years	15	56.73±11.23
From 20-30 years	29	63.10±14.47
From 30-50 years	35	64.00±11.01
From 50 -60 years	17	66.12±19.08

DISCUSSION.

In spite of the fact that Saudi Arabia is located at 18^{o} latitude and sunshine is adequate all year round[14], vitamin D deficiency among the participants of this study was high (86.5%), which is also supported by many other reports from Saudi Arabia[15-18]. However, some reports found that lifestyle may influence vitamin D level more than the latitude [19].

At the beginning of the study, the serum levels of vitamin D of subjects were recorded 13.77±6.09, 13.60±5.22, 15.89±10.07 and 16.55±9.38 ng/ml for group ranges 10-20, 20-30, 30-50 and above 50 years respectively with the conclusion that 45.82% of the participants are suffering from vitamin D insufficiency and 54.1% for relative insufficiency in the Saudi population residing in Hotat BeniTammim. Despite living in one of the sunniest part of the world ,further we observed that female gender and younger age were found more prone to vitamin D deficiency or relative insufficiency. These results suggest that vitamin D insufficiency is common even in very sunny areas emphasizing the importance of screening for vitamin D deficiency in these populations. Our observation that vitamin D deficiency or insufficiency is common among the Saudi nationals living in HotatBeniTammimis consistent with prior studies conducted in different areas of the Kingdom of Saudi Arabia[7, 20].

As mentioned before, females in our study had a significantly lower level of vitamin D (11.48ng/ml) versus 18.49 ng/ml in males ($p<0.05$),still higher than the data from Elsammak et al.[21].Another study reported bySadat et al.,[22]also show 10% prevalence of vitamin Dless than normal levels (50 nmol/L) in healthy Saudi men with a mean age of 28.5 years in eastern Saudi Arabia.

Similar results of vitamin D deficiency or relative insufficiency was observed in other parts of the Gulf countries such as, Qatar where the mean vitamin D level was determined29.2 nmol/L among healthcare professionals which was found lower in females (25.7 nmol/L) than in males (34.2 nmol/L)[23]. In another study 97% of all study participants had a mean level <75 nmol/L while 87% had a mean level of <50 nmol/L[24].

Belgium is closer to the north pole, demonstrated higher prevalence of vitamin D deficiency (77%) among adults living in Brussels[25]. These studies suggest that the deficiency of vitamin D cannot rely on the sun exposure alone for a good vitamin D status even in sunny countries. A low vitamin D status could be a concern not only in female and the elderly in Saudi Arabia, but also in the younger age groups and adult's men. Females had approximately 6-fold higher prevalence of vitamin D deficiency or relative insufficiency than males (11.48±6.30 ng/mlfor females, 18.49±8.30 ng/ml for males). This was consistent with other studies [26]. However, these findings demonstrate that the degree of severity of vitamin D deficiency in our cohort was inversely related to age.

Many studies reported that age is an independent predictive risk factor for vitamin D deficiency[7], and unlike other reports, this study documented that vitamin D deficiency was associated with younger age. Few studies supported this finding[27, 28], however, other studies found that vitamin D deficiency was more among elderly people. Moreover, eldersare at high risk for vitamin D deficiency [7, 20, 22].

A number of factors are associated with vitamin D deficiency, these are: low vitamin D intake, racial (dark skin), high BMI, young age group, low fish consumption and shorter duration outdoors sun exposure [28].

In this study, vitamin D level was found increased with age, opposite to other reports as the study of Nakamura et al., [28]who found that serum 25(OH)D level decreased with increasing age. This may be attributed to the fact that aging decreased the capacity of the skin to produce 7-dehydrocholesterol[29].

The life style of Saudi subjects such as no sun exposure and the high body fat mass which leads to limited bioavailability of vitamin D caused by the trapping of vitamin D in adipose tissue may further increase the risk of vitamin D deficiency[30].

Our findings are similar to the local observations made by Al-Daghri et al,[12] which suggested that although summer sun exposure in Middle Eastern and Gulf states are minimal, an increase may occur during winter when the weather heat is less harsh, and this could raise vitamin D levels [12].

CONCLUSION

In conclusion, vitamin D deficiency was common among Saudi males and females who reside in HotatBaniTammim, South of Riyadh. We believe that more attention should be given to vitamin D status among Saudi population because it is an important vitamin for regulation of calcium metabolism and

maintain good health, which is unfortunately lacking in most of Saudi population. Sunlight exposure needs to be increased for these peoples by encouraging them to involve in more outdoor activity during the daytime. They should expose their skin (e.g., face, arms and hands) to the sun to produce sufficient levels of vitamin D for optimal overall health. Vitamin D fortification should be increased. Finally, effective education programs at the national level targeted Saudi population are needed to elevate the public awareness of this serious problem.

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