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Original Research Article.

Vitamin D Deficiency Among Saudi Adolescents According to Increased Body Mass Index

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ABSTRACT

Background: Adolescents are specifically at higher risk of hypovitaminosis D due to the increasing tendency to sedentary lifestyle, with excessive TV and computer use as well as unhealthy dietary habits.

Objectives: To determine the prevalence of vitamin D deficiency among Saudi Arabian adolescents according to the body mass index, gender, daily sun exposure, daily milk consumption and fish or tuna consumption.

Subjects and Method: A comparative cross-sectional study was conducted on 48 Saudi adolescents, aged 11-19 years school-aged males and females in the primary care centers in Jeddah, Saudi Arabia; 24 had normal weight, 24 had increased body weight. Study was carried out during two months from December 2011 to February 2011. 25 hydroxyvitamin D levels were measured in both groups.

Results: Over all the prevalence of severe deficiency vitamin D among all study participants was (60.4%), the prevalence moderate deficiency was (39.6%) while the prevalence of the sufficient vitamin D level was (0%). The female had severe deficiency of vitamin D than male with statistically significant difference, P-value was 0.01. There was statistically significant difference in the mean of vitamin D between normal weight and obese adolescents, P-value was 0.034. The adolescents who had history of no sun exposure, history of fish or tuna consumption less than three times /week had severe deficiency vitamin D (less than 10 ng/mL) than those who had history of sun exposure but it was not standard sun exposure, history of fish or tuna consumption three times or more /week with statistically difference, p-values were 0.006 and 0.002 respectively.

Conclusion: Vitamin D deficiency highly prevalent in adolescents in and probably in Saudi Arabia which is largely attributed to poor exposure to sun light and poor dietary vitamin D supplementation. Severe vitamin D deficiency is common in female adolescents. Obese adolescents group had very low mean level of vitamin D.

Keywords: Vitamin D, Deficiency, Adolescents, Prevalence.

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INTRODUCTION

Recent studies indicate that vitamin D insufficiency (less severe than deficiency) is associated with a wide range of diseases and chronic conditions, including type 1 diabetes mellitus, hypertension, multiple sclerosis, and several types of cancers, such as breast, colon, and prostate cancer.[1-3]

Vitamin D deficiency among healthy adolescents was reported as 78% in France,[4] 65% in Finland,[5] 65% in Turkey[6] 52% in Beirut,[7] 46.2% in Iran,[8] 42% in Boston,[9] and 29% in Switzerland.[10] Vitamin D deficiency has been associated with obesity in studies carried out among adolescents in Turkey,[11] United States,[12] Italy[13] and Saudi Arabia.[14] Vitamin D deficiency is common in females more than in males.[12, 14]

Adolescents are specifically at higher risk of hypovitaminosis D due to the increasing tendency to sedentary lifestyle, with excessive TV and computer use.[13]

This study aimed to determine the prevalence of vitamin D deficiency among Saudi Arabian adolescents according to the body mass index, gender, daily sun exposure, daily milk consumption and fish or tuna consumption.

SUBJECTS AND METHODS

This was a comparative random sample cross-sectional study conducted on 48 Saudi adolescents' males and females school-aged in the primary care centers in Jeddah, aged between 11 and 19 years.

Twenty-four had normal weight; twenty-four had increased body weight. Samples were collected during two month from January 2012 to March 2012. Exclusion criteria were adolescents with any systemic disease or using any medications or supplements known to affect skeletal metabolism.

A total of 10 ml blood was extracted from each participant by a nurse into a non-heparinized Vacutainer tube. Vitamin D was measured using the Elecsys 25OHD assay (Roche Diagnostics GmbH, Mannheim, Germany). Our subjects were divided into two groups: Normal weight group and increase body mass index group then body mass index group divided into overweight group and an obese group. According to 25 hydroxyvitamin D level, the subjects in every group were divided into three groups :Group (A) Deficiency: if the level is less than 20 ng/mL (50 nmol/L), Group (B) Insufficient: if the level is between 20 to 30 ng/mL (50 to 75 nmol/L and Group (C) Sufficient: If the level is more than 30 ng/ml (75nmol/L)t hen Group A was divided into two subgroups according to 25 hydroxyvitamin D level Group (A1): Severe deficiency if the level was less than 10 ng/mL (25 nmol/L) and Group (A2): Moderate deficiency(if the level is equal or more than 10 ng/mL and less than 20 ng/mL (25 nmol/L-50nmol/l).

Sun exposure was categorized into: Standard sun exposure (if there was sun exposure to arm and legs for 10-30 min twice/ week), Non-standard sun exposure (if there was sun exposure to hand and face at least 10 mints. for at least 5 days /week), No exposure or limited exposure.

Milk or liquid yoghurt consumption daily was categorized into sufficient (if there was at least 4 cups of milk or liquid yoghurt consumed daily), insufficient consumption (<4 cups daily), and no consumption. Fish or tuna consumption categorized to: daily, three times/week, and other.

Ethical approval to conduct the study was obtained from The National Olympiad for scientific creativity in Riyadh (Ibdaa, 2012).

Data entry and analysis was performed using Statistical Package for Social Science, version, 21. Chi-square and student`s t-test were used for analysis of data and p-value less than 0.05 was considered for statistical significance.

Table 1: Socio-Demographic, clinical and relevant characteristics of study group (n= 48)

Variables		No. (%)
Gender	**Males**	27 (56.2%) (12 increase body mass index+ 15 normal body mass index)
	Female	21 (43.8%) (12increase body mass index + 9 normal body mass index)
Age (years) Mean (SD)		15.31 ±2.72
Height, Mean + SD		157.60±11.0
Weight , Mean + SD		65.40±24.8
BMI, Mean + SD		26.0 ±8.3
25 (OH) vitamin D (ng/ml)	**Mean +SD**	8.98±2.7
	Range	(4.4-16.4)
25 (OH) vitamin D level	**Group (A1) (<10ng/ml severe deficiency)**	29 (60.4%)
	Group (A2) (10-20 ng) moderate deficiency	19 (39.6%)
	Group (B) (>=20-30ng/ml) insufficiency	0
	Group (c) (>= 30ng/ml) sufficiency	0
SUN EXPOSURE AND DIETARY CHARACTERISTICS		
Sunlight exposure	**Standard exposure**	0.0
	Nonstandard exposure	29 (60.4%)
	No exposure or less	19 (39.6%)
Daily milk consumption	**Sufficient**	0.0
	In sufficient	7 (15%)
	No milk consumption daily	41 (85%)
Fish or tuna consumption	**Daily**	0.0
	Three times / week	16 (33.3%)
	Other	32 (63.6%)

Table 2: Vitamin D status of subjects by gender

25 (OH) vitamin D	Males (%)	Females (%)	Total (%)	P-value
Group (A1) (<10ng/ml) sever deficiency)	12 (44.4)	17 (81.0)	29 (60.4)	**0.010**
Group (A2) (10-20 ng) moderate deficiency	15 (55.6)	4 (19.0)	19 (39.6)	
Group (B) (>=20-30 ng/ml) deficiency	0 (0.0)	0 (0.0)	0 (0.0)	
Group (c) (>= 30ng/ml) sufficiency	0 (0.0)	0 (0.0)	0 (0.0)	
Total (%)	27(100)	21 (100)	48 (100)	

Table 3: Vitamin D status by obesity status:

25 (OH) vitamin D	Normal weight n (%)	Overweight n (%)	Obese n (%)	Total (%)	P-value
Group (A1) (<10ng/ml) sever deficiency)	12 (50)	3 (50)	14(77.8)	29(60.4)	**0.160**
Group (A2) (10-20 ng) moderate deficiency	12 (50)	3 (50)	4 (22.2)	19(39.6)	
Group (B) (>=20-30 ng/ml) deficiency	0(0)	0(0)	0(0)	0(0)	
Group (c) (>= 30ng/ml) sufficiency	0(0)	0(0)	0(0)	0(0)	
Total (%)	24(100)	6(100)	18(100)	48(100)	

RESULTS

A total of 48 Saudi adolescents, aged 11-19 year; 24 had normal weight and 24 had increased body weigh were included in this study. Their socio-demographic and relevant characteristics are shown in table 1. The prevalence of severe deficiency vitamin D was 29 (60.4%) whereas the prevalence moderate deficiency was 19 (39.6%).

The female adolescents had severe deficiency vitamin D more than male with statistically difference; (81% versus 44.4%), p-value was 0.010 as shown in table 2. Although there was no significantly difference in prevalence of vitamin D deficiency in our study according to increased body mass index, there was statistically difference in the mean of vitamin D between normal weight and obese adolescents, p-value was 0.034 as illustrated in tables 3 and 4. The adolescents who had history of no sun exposure had severe deficiency vitamin D (less than 10 ng/mL) compared to their counterparts as shown in table 5, p-value was 0.006. Adolescents with history of fish or tuna consumption less than three times/week were more likely to have severe vitamin D deficiency than those who consumed fish or tuna more than three times/week (61% versus 37.5%), p=0.002. (Table 6)

Daily consumption of milk was not significantly associated with vitamin D status as illustrated in figure 7.

Table 4: Mean of 25 (OH) D according to BMI of studied sample

Variable	Normal weight (n= 24)	Obese (n= 18)	Total (n=42)	P-value
25 (OH) vitamin D	9.63± 2.63	7.91± 2.31	8.98± 2.61	**0.034**

Table 5: Relation of Vitamin D status to sun exposure daily

25 (OH) vitamin D	NO standard exposure	No exposure	Total (%)	P-value
Group (A1) (<10ng/ml) sever deficiency)	13(44.8)	16(84.8)	26(60.4)	**0.006**
Group (A2) (10-20 ng) moderate deficiency	16(55.2)	3(15.2)	19(39.6)	
Total (%)	29(100)	19(100)	48 (100)	

Table 6: Relation of Vitamin D status to fish or tuna consumption

25 (OH) vitamin D	Fish or tuna consumption three times /week	Fish or tuna consumption less than three times /week	Total (%)	P-value
Group (A1) (<10ng/ml) sever deficiency)	6(37.5)	23(71.9)	26(60.4)	
Group (A2) (10-20 ng) moderate deficiency	10(62.5)	9(28.1)	19(39.6)	**0.002**
Total (%)	16(100)	32(100)	48 (100)	

Table 7: Relation of Vitamin D status to milk daily consumptions

25 (OH) vitamin D	In sufficient consumption	No consumption	Total (%)	P-value
Group (A1) (<10ng/ml) sever deficiency)	4 (57.1)	25 (61.0)	26(60.4)	**0.840**
Group (A2) (10-20 ng) moderate deficiency	3 (42.9)	16 (39.0)	19(39.6)	
Total (%)	7 (100)	41 (100)	48 (100)	

DISCUSSION

The prevalence of severe deficiency vitamin D in the present study among Saudi adolescents (11-19 years) was 60.4% whereas the prevalence moderate deficiency was 19 39.6%. In a recent study carried out in Italy among healthy adolescents, the prevalence of hypovitaminosis D was 82.2%; vitamin D deficiency and insufficiency were detected in 49.9% and 32.3% of adolescents, respectively. Among those with deficiency, 8.9% were severe deficient.[15] Also, our results are in accordance with other reported from other countries around the globe.[16-21] Being sedentary reduces time spent outdoor in sunlight on one side and

on the other side it increases the risk of obesity, which is another risk factor for hypovitaminosis D.[22-24] Adolescence is a period of rapid growth and bone mineral accrual[25,26] during which vitamin D status should be maintained within the optimal range. Indeed, vitamin D plays a role in the achievement of peak bone mass (PBM) during adolescence.[25,27,28] In the present study obese subjects had lower significant level of vitamin D compared to normal subjects. In an Italian study, BMI was shown to significantly affect vitamin D status, with overweight and obese adolescents being at a higher risk of vitamin D deficiency.[15]

Our results also are in accordance with previous studies in this regards.[13,29-31]This is most likely due to the decreased bioavailability of vitamin D because of its deposition in body fat compartments.[32] Moreover, adiponectin has been recently identified as a key plasma protein that links vitamin D deficiency to pediatric obesity.[33]

The present study reported that severe vitamin D deficiency was more significantly observed among female adolescents. The same finding has been reported by others.[34,35] This could be attributed partially to cultural attitudes towards sun exposure and concealing clothes. However, other studies did not find a gender difference.[13,36,37]

The adolescents who had history of no sun exposure had more severe deficiency vitamin D compared to their counterparts. It has been reported in a study done by Binkley et al that the high prevalence of low vitamin D status is assumed to result from inadequate sun exposure.[38]

The present study revealed that adolescents with history of fish or tuna consumption less than three times/week were more likely to have severe vitamin D deficiency than those who consumed fish or tuna more than three times/week. According to nutrient databases, 100-gram serving of salmon contains between 361 and 685 IU of vitamin D and also Canned light tuna contains up to 236 IU of vitamin D in a 100-gram serving, which is more than half of the reference daily intake of vitamin D which is 400 IU.[39]

This study is limited by its cross-sectional design which permits only association and not causality between variables. Also by its relatively small sample size and its conduction in only one city in the Kingdom of Saudi Arabia which might limits its generalizability. Despite of those limitations, it has an important public health implication on the community by exploring this important issue.

In conclusion, vitamin D deficiency is highly prevalent among adolescents in and probably in Saudi Arabia which is largely attributed to poor exposure to sun light and poor dietary vitamin D supplementation. Severe vitamin D deficiency is common in female adolescents obese adolescents group had very low mean level of vitamin.

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