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RESEARCH ARTICLE

The Delineation of 'Vitamin D' Deficiency among Iranian Students: an Attempt to Establish its Potential Association with Obesity

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Abstract

Vitamin D deficiency is a worldwide public health problem and is recognized as a pandemic in the recent years. This cross-sectional study was conducted on a total sample of 354 students to determine the prevalence of 'Vitamin D' deficiency and its relationship with obesity among Iranian students. Data was collected using the measurement of circulating form of 25-hydroxy Vitamin D [25(OH) D] and Body Mass Index (BMI) which were further analyzed using descriptive and analytical statistics via the SPSS18 software. No significant relationship between the circulating level of vitamin D and BMI was evidenced. Only 15% of female students who had a Vitamin D deficiency, were overweight and obese, but the same frame 28.9% of the male students. Further, the prevalence of Vitamin D deficiency was significantly higher in the male students rather than females. Conclusively, the prevention, diagnosis, and treatment of Vitamin D deficiency must be important in this age group. Since no statistically significant relationship was found between Vitamin D deficiency and obesity, further studies are suggested to investigate this association, especially in obese people.

Introduction:

Vitamin D deficiency is a worldwide public health problem and is recognized as a pandemic in recent years (Holick *et al.*, 2008). Vitamin D is the most important factor in bone homeostasis and mineral metabolism especially calcium and phosphorus. It has an important role in bone strength (Shakiba & Rafiei, 2009). There is no consensus regarding the circulating level of 25-hydroxyvitamin D. However, a circulating level of> 20 ng/ml is considered as a vitamin D deficiency and the level of >30ng/ml is required to maximize vitamin D's beneficial effects for health (Talaei *et al.*, 2011). Vitamin D deficiency is associated with metabolic bone diseases, autoimmune diseases, diabetes, cardiovascular diseases, schizophrenia, multiple sclerosis (MS), polycystic ovary syndrome and obesity (Cantorna *et al.*, 2004; Garland *et al.*, 2006; McGrath *et al.*, 2002 & Talaei *et al.*, 2011; 2013). Now, Vitamin D deficiency has also been reported in most developed and developing countries. In the Persian Gulf states such as Saudi Arabia, Kuwait and Jordan, despite adequate sunlight exposure, vitamin D deficiency is highly prevalent (Al-Jurayyan *et al.*, 2002; Souberbielle *et al.*, 2001). The prevalence of vitamin D deficiency in developing countries such as Iran, Saudi Arabia and Qatar is 20 percent higher than developed countries like Denmark and Australia (Plehwe, 2003). In Iran, the high prevalence of vitamin D deficiency has been reported in different age groups (Salek, 2007). Also, according to the findings of a study on vitamin D in Iran, there is an increasing trend of micronutrient deficiencies among individuals from 2000 to 2011 (Alizadeh *et al.*, 2015). In recent years, the relationship between vitamin D deficiency and obesity has been considered and various studies have shown a significant relation between the low level of vitamin D and obesity (Mai *et al.*, 2013; Jorde et al., 2010; Ding *et al.*, 2010 & Benjamin *et al.*, 2009). In many studies obese people had a lower circulating level of 25-hydroxy vitamin D than people with a normal weight, which seems to be the result of this fat-soluble vitamin is stored in fat tissues (Wortsman *et al.*, 2000).On the other hand, a reduction of the circulating level of 25-hydroxy vitamin D leads to the loss of calcium inside adipose tissues, lip genesis and an increase in body weight (McCarty *et al.*, 2003). Some randomized clinical trials

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have shown the beneficial effects of vitamin D on the regulation of body weight (Major *et al.*, 2009). According to the World Health Organization (WHO) from 1980 to 2013, the number of people suffering from obesity has doubled in the world (WHO, 2015). Iran also faces the growing trend of this chronic disease (Arunabh *et al.*, 2003). By keeping in mind the prevalence of vitamin D deficiency, obesity and the relationship between vitamin D deficiencies with obesity we aimed to determine the prevalence of vitamin D deficiency and its relationship with the obesity among Iranian students.

Methodology:

The present research was a descriptive cross-sectional study conducted between two group that was carried out after getting approval with IR.JUMS.REC.1394.075 and confirming by an ethics committee of Jahrom medical science university with number 1390.

It was conducted to determine the prevalence of Vitamin D deficiency and its association with obesity. A convenience sampling technique - Random Allocation Software was used to select the participants from Jahrom University of Medical Sciences. Hence, the final sample size was calculated at 375 students. In this study, a lack of consumption of Vitamin D supplements or injection drugs during the last 6 months, having no fat mal-absorption, diarrhea and chronic diseases as well as no using of anti-convulsants were the inclusion criteria. Before data collection participants were informed about the aim and method of this study and a written consent was taken (Shahla *et al.*, 2005).

The samples in this study were first selected purposively then were divided into two groups randomly using the Random Allocation Software. In this regard, each researcher was provided a questionnaire about the inclusion criteria to the students.

Data was collected using the physical examination of 20-25 years old male and female students. For measuring height and weight, Seca scales and fabric meter attached to the wall were used. BMI was calculated by dividing the subject's mass by the square of height. To assess the circulating level of 25-hydroxy vitamin D [25(OH) D] the ELISA method was used; in this respect, 2 ml of venous blood was taken from each participant to measure the circulating level of Vitamin D. The blood samples were taken from 6 to 10 A.M in the laboratory. Since the normal circulating level of Vitamin D is between 30-50 ng/ml, in this study the level of < 20 ng/ml and between 20-30 ng/ml was considered as Vitamin D deficiency and insufficiency, respectively. Also, the level of >30 ng/ml was considered as Vitamin D sufficiency. The BMI was classified into four sections: less than normal (< 18.5), normal (18.5 to 24.9), overweight (25 to 29.9) and obese (>30). Data was analyzed using descriptive and analytical statistics. Chi-square test was used to assess an association between Vitamin D status and body mass index (BMI). The significance level for all tests was considered while $p < 0.05$.

Results:

Overall, 354 students consisting of 161 (45.7%) males and 191 (54.3%) females participated in the study. The mean age of the participants was 23.31 (SD = 2.35) years. The means of the circulating level of Vitamin D were 44.5 (±29.1) and 27.9 (±15.5) in the female and male students, respectively. Also, the mean of BMI in the female and male students was reported as 22.0 4 (±3.4) and 23.3 (±4.0), respectively. With regard to the prevalence of Vitamin D deficiency (the level of < 20 ng/ml), it was 20.9% in the female and 27.9% in the male students. The chi-square test indicated a significant relationship between gender, the level of Vitamin D and BMI (Table-1). Moreover, no significant relationship was found between the level of vitamin D and BMI between the female and male students ($p > 0.05$). Only 15 percent of the female students with low levels of vitamin D were overweight and obese, though 28.9 percent of the male students had this condition (Table-2)..

Table 1: Relationship between gender with level of Vitamin D & BMI

Variable	BMI	Level of vitamin D (<20)*	(20-30)**	(>30)***	Statistics Chi-sq.
Female	Lower than normal	5(12.5)	2(5.4)	10(8.8)	4.44
	Normal	29(72.5)	33(89.2)	87(76.3)	
	Overweight	4(10.0)	1(2.7)	13(11.4)	
	Obese	2(5.0)	1(2.7)	4(3.5)	
Male	Lower than normal	4(8.9)	5(7.7)	3(5.9)	3.36
	Normal	28(62.2)	38(58.5)	34(66.7)	
	Overweight	9(20.0)	18(27.7)	13(25.5)	
	Obese	4(8.9)	4(6.2)	1(2.0)	
p> 0.05		*Deficiency, **Insufficient, ***Sufficient			

In general, the positive and significant association was seen between age and MetS morbidity ($p<0.001$, $r=0.287$). However, this association was not significant in Turkman group. Age cut-off values for predicting MetS was 33.5 years in Turkman, 50.5 years in non-Turkman and 42.5 years in total of subjects.(Table 2) The AUCs ranged from 0.546 in Turkman group to 0.726 for non-Turkman group. The values for AUC tended to be higher in non-Turkman and in total of subjects. (Graph1) .

Discussion and conclusions:

As per our survey, there is no statistically significant relationship was revealed between the serum level of Vitamin D and BMI. Conversely, Arunabh *et al.*, (2003) showed a statistically significant relationship between obesity and a low level of Vitamin D. According to two

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Table 2: The relationship between the level of vitamin D and BMI among females and males

Variable N(%)	Level of vitamin D (<20)*	(20-30)**	(>30)***	BMI (<18.5)[a]	(18.9-24.9)[b]	(25-29.9)[c]	(>30)[d]	p value
Female	40(20.9)	37(19.4)	114(59.7)	12(7.5)	100(62.1)	40(24.8)	9(5.6)	
Male	45(27.9)	65(40.4)	51(31.7)	17(8.9)	149(78.0)	18(9.4)	7(3.7)	
Chi squared	29.69*				1.66*			< 0.05

*Deficiency, **Insufficient, ***Sufficient; [a]Lower than normal, [b]Normal, [c]Overweight, [d]Obese

cohort studies conducted on North Americans and African Americans, the increased fat mass and body mass index had statistically significant association with Vitamin D deficiency (Devaraj *et al.*, 2011 & Aloia *et al.*, 2008). Another study conducted on menopause women in high altitude areas in England also showed that the production of Vitamin D in the body of individuals with the BMI higher than 34 was 10% lower as those people with a normal weight (Macdonald *et al.*, 2008). Other studies around the world reflected the relationship between Vitamin D deficiency and obesity compared with normal weight people. For instance, in a study by Forrest *et al.* (2011) on adult population in America, the prevalence of Vitamin D deficiency in obese people was reported at about twice normal weight adults. In other Iranian studies, the relationship between the serum levels of Vitamin D and obesity was reported. In a study on women 15-49 years old in Tabriz, statistically significant correlations were observed between the levels of Vitamin D and weight and BMI (Alshahrani *et al.*, 2014).

Some other studies have shown controversial findings with regard to the relationship between obesity, being overweight, and Vitamin D. For instance, in a study conducted on 3669 healthy adults living in five large cities in Iran, statistically significant relationship was not found between BMI and Vitamin D (Khashayar *et al.*, 2013). Karimi *et al.* (2014) studied the prevalence of Vitamin D deficiency, BMI and waist circumference in female adolescents aged 14-17 years old in Bokan city, Iran and found no such relationship. Such contradictions in the findings of these studies stem from differences in the methodology, samples and methods used to measure 25-hydroxyvitamin D. Since the findings of cross-sectional studies do not suggest a causal link, there are also needs for conducting cohort studies, clinical trials and systematic reviews, and meta-analysis for confirming the results.

We also found that there was a statistically significant relationship between gender and Vitamin D as the male students had more vitamin D deficiency compared to the female students. Other studies reported that female students suffered more from Vitamin D deficiency in comparison with their male counterparts. In a study on the association between Vitamin D deficiency and cardiovascular disorders on 547 female and male people aged between 30 and 60 years old, the majority of females suffered from cardiovascular disorders (El-Menyar *et al.*, 2012). According to the findings of another study, on male and female students aged 18-33 years from the Middle East and living in London, Ontario and Canada, the prevalence of vitamin D deficiency was higher in female students (Alshahrani, 2014). A study conducted in Iran in between 2000 to 2011 reflected the severe Vitamin D deficiency in women while compared to men (Saeedinia *et al.*, 2013). Despite these conflicting results, some studies found the higher level of Vitamin D deficiency in males than females (Johnson *et al.*, 2012). In the study by Johnsom *et al.* (2012) with 2026 participants, the prevalence of vitamin D was reported higher in males than females. One limitation of this study was a lack of data collection on the amount of Vitamin D from food intake and the accurate calculation of hours of exposure to sunlight. Also, since one of the factors affecting serum levels of vitamin D is individuals' genetics such an assessment was impossible.

Surprisingly, in our study, we found a drastic difference in the means of the circulating level of Vitamin D recorded between male and female. However, in the present scenario, we are not in a position to forward any concrete reason to support our abrupt data, but we could speculate that during the time of our sample collection, most of the males participated in our study were not even taken their breakfast, and we were having no other alternative time to collect the samples. Probably taking a sample of the subjects (male) in their empty bowl conditions could be the reason why they show poor Vitamin D.

Conclusively, weekly exposure to sunlight and the use of foods containing vitamin D in diet programs are suggested. Since no statistically significant relationship was found between vitamin D deficiency and obesity, further studies are suggested to investigate this association, especially in obese people.

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