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Original Article

The prevalence of vitamin D deficiency-insufficiency in medical faculty students

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Abstract

Aim: The vitamin D deficiency is a pandemic health problem due to worldwide modernization. We tried to determine the impact of the reduced sun exposure on the vitamin D levels of the medical faculty students due to the long study hours and indoor study environment and classrooms.

Material and Method: Two-hundred and eleven (113 women, 98 men) medical faculty students were included in the study. Blood samples were obtained from the students and serum 25 hydroxyvitamin D3 levels were measured on the same day. Students were healthy individuals, aged 17-29 years (mean age= 19 years). Data were analyzed using SPSS software program. The frequency distribution of the qualitative data and arithmetic mean, minimum, maximum and standard deviation of the quantitative data were used to define descriptive statistics. Non-parametric tests and Chi-square test were used for the analysis of qualitative data; the analysis of the quantitative data was done by observing normally distributed data. The significance level of Chi-square test, independent-student t-test and Mann-Whitney U test were accepted as p≤0.05.

Results: Serum 25 hydroxyvitamin D3 levels was below 20 ng/ml in 56% (n=118) of the students, of which 72% (n=85) were women.

Conclusion: Especially, women had high levels of vitamin D deficiency in our study. This high ratio gives rise to thought that women spend more of their time indoor spaces due to modernization., women are exposed to sun light less than men, and thus they have higher levels of vitamin D deficiency.

Keywords: Vitamin D; Medical Faculty Students; Vitamin Deficiency.

INTRODUCTION

Vitamin D, besides being a vitamin, is among the fat-soluble sterols, and have hormonal effects. Moreover, it provides bone mineralization through calcium and phosphate metabolism (1,2). Recently, vitamin D deficiency has been found to be associated with various chronic diseases including autoimmune disorders (3,4).

Although, the major source of vitamin D is the endogenous production of vitamin D3 (cholecalciferol) from 7 dehydrocholestorel in the skin by exposure to ultraviolet B photons, it is converted to the inactive forms of vitamin D3 as a result of prolonged sun exposure. Besides, vitamin D can be obtained from dietary sources of vegetal (ergocalciferol or vitamin D2) and animal origin (vitamin D3 or cholecalciferol). Vitamin D is mostly found in fish, liver, egg yolk, dairy products, sweet potato, oat and mushroom. Dietary or endogenously produced vitamin D2 or vitamin D3 is stored in fat cells and released to the circulatory system when needed (5,6). Vitamin D from the skin synthesis or diet is biologically inactive. It is converted to 25-hydroxyvitamin D by 25-hydroxylase enzyme in the liver, and then, to 1,25-dihydroxyvitamin D, the biologically active form of vitamin D by 1-alpha hydroxylase enzyme in kidneys. 1-alpha hydroxylase enzyme is the key enzyme in the synthesis of vitamin D. It is regulated by parathormone, calcium, phosphate and fibroblast growth factor 23 (5,6). 1,25-dihydroxyvitamin D shows its effect on vitamin D receptors in small intestine, kidneys and other tissues. Its regulates blood calcium levels by enhancing calcium absorption from the kidneys and decreasing Ca loss from kidneys (7). If 25-hydroxyvitamin D level is below 20 ng/ml, it is accepted as vitamin D deficiency; if it is between 21 and 29 ng/ml, it is accepted as vitamin D insufficiency; if it is over than 30 ng/ml, it is accepted as normal and if it is over than 150 ng/ml, it is accepted as vitamin D intoxication (5,7) So we tried to determine the impact of the reduced sun exposure on the vitamin D levels of the medical faculty students due to the long study durations and indoor study environment and classrooms.

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MATERIAL and METHODS

Two-hundred and eleven (113 women, 98 men) medical faculty students were included in the study after obtaining the required permits for the study. Students were healthy individuals, aged 17-29 years (mean age= 19 years) (Table 1).

Table 1. Age and serum vitamin D levels of some students

No	Age of Women	No Age of Women	Age of Men	Vitamin D levels of Men (ng/ml)
1	19	5.17	19	121.56
2	21	4.45	21	20.91
3	18	3.99	22	21.35
4	19	2.78	19	22.65
5	19	3.75	18	21.19
6	19	5.05	20	25.39
7	20	3.12	19	18.64
8	18	2.49	24	19.91
9	19	4.98	19	22.76
10	21	2.49	18	26.31
11	20	4.95	19	28.64
12	17	2.55	18	21.91
13	18	3.99	19	25.61
14	19	4.62	19	26.76
15	19	5.11	20	28.05
16	18	4.58	19	30.64
17	18	4.95	19	28.04
18	19	3.75	18	17.96
19	21	2.98	17	19.39
20	18	3.81	22	23.19
21	18	1.73	20	34.29
22	18	5.17	20	43.04
23	18	4.04	20	28.16
24	19	83.97	19	11.8
25	18	21.87	19	29.23
26	20	20.9	20	21.54

Students having a disease leading to vitamin D deficiency (hepatic, intestinal or renal disease) and those using drugs causing vitamin D deficiency (corticosteroid, anticonvulsant or bile acid binding drugs) were excluded from the study. Blood samples were obtained from the students and studied in the biochemistry laboratory of the Medical Center Hospital on the same day. Blood samples were centrifuged at 3000 g for 12 minutes, and serums containing 25-hydroxyvitamin D2/D3 were obtained. Vitamin D2/D3 levels were analyzed by using on-line SPE HPLC device compatible with tandem mass spectrometry (LC-MS/MS). MS7000 and MS7100 ClinMass® Complete Kits were used. Following the chromatographic separation with HPLC system, ionization was done with APcI and measurements were performed with tandem mass spectrometry (MS/MS). The measurements were monitored by using Multiple Reaction Monitoring (MRM) (Table 2).

Table 2. Distribution according to the gender when the cut off value of serum vitamin D is ac-cepted as 20 ng/ml

			Vitamin D Level		
			<20 ng/ml	>20 ng/ml	Total
Gender	Women	Count	85	28	113
		Expected Count	63.2	49.8	113,0
		% within Gender	75.2%	24.8%	100,0%
	Men	Count	33	65	98
		Expected Count	54.8	43.2	98,0
		% within Gender	33.7%	66.3%	100,0%
Total		Count	118	93	211
		Expected Count	118,0	93.0	211.0
		% within Gender	55,9%	44.1%	100.0%

Data were analyzed using SPSS software program. The frequency distribution of the qualitative data and arithmetic mean, minimum, maximum and standard deviation of the quantitative data were used to define descriptive statistics. Non-parametric tests and Chi-square test were used for the analysis of qualitative data; the analysis of the quantitative data was done by observing normally distributed data. The significance level of Chi-square test, independent-student t-test and Mann-Whitney U test were accepted as $p \leq 0.05$ (Figure 1).

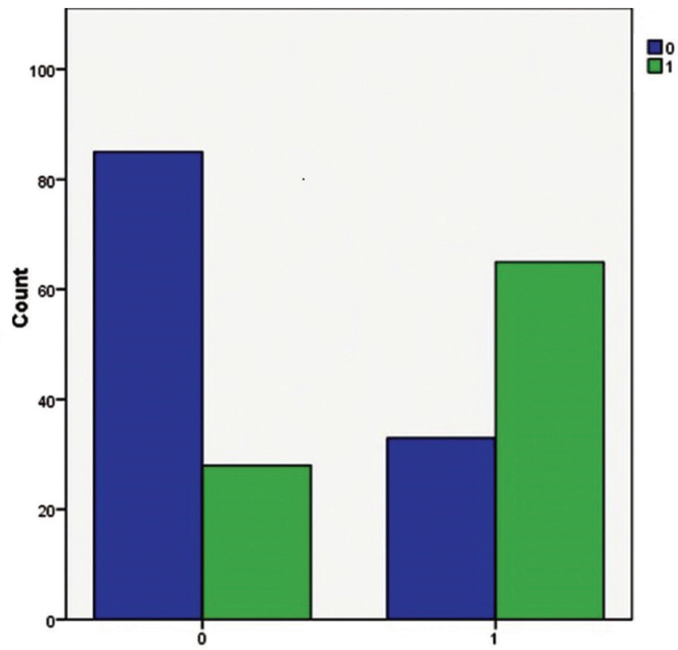

Figure 1. Distribution according to gender and vitamin D levels (0= women, 1= men and Blue= Vitamin D deficiency; <20 ng/ml, Green= Normal vitamin D level; >20 ng/ml)

RESULTS

The study population included 211 students with mean age of 19.03 years; 98 men (mean age; 19.23 years) and 113 women (mean age; 18.85). The minimum and maximum vitamin D levels in women was 1.73 ng/ml and 83.97 ng/ml, respectively. The mean vitamin D level in women was 15.13 ng/ml. The minimum and maximum vitamin D levels in men was 10.70 ng/ml and 121.56 ng/ml, respectively. The mean vitamin D level in men was 23.78 ng/ml.

In the present study, when the cut off value of serum vitamin D was accepted as 20 ng/ml, 55.9% of the students had serum 25-hydroxy vitamin D3 levels below 20 ng/ml (n=118), and 72% of those were women (n=85).

Among these women, 16.8% had the vitamin D level of <5 ng/ml, which means at the level of severely deficient. In men, severely deficit vitamin D levels were not detected. Of the 98 men, 33 (33.7%) had serum vitamin D3 levels below 20 ng/ml, and of the 113 women, 85 (75.2%) had serum vitamin D3 levels below 20 ng/ml (Figure 2).

In the present study, serum vitamin D levels were assessed as; severe deficiency (<5 ng/ml), moderate deficiency (5-9.9 ng/ml), mild deficiency (10-19.9 ng/ml), insufficiency (20-30 ng/ml) and normal level (>30 ng/ml). Of the women, 75% (n=85) had vitamin D deficiency and 21.3% (n=24) had vitamin D insufficiency. Only, 3.5% (n=4) of the women had normal vitamin D levels. In men, 33.7% (n=33) had mild vitamin D deficiency and none of them had severe or moderate vitamin D deficiency. Of the men, 55.1% (n=54) had vitamin D deficiency and only 11.2% had normal vitamin D levels. In total, 9% of all students (19 women) had severe deficiency (<5 ng/ml), 10% (21 women) had moderate deficiency (5-9.9 ng/ml), 37% (45 women, 33 men) had mild deficiency (10-19.9 ng/ml) and 37% (24 women, 54 men) had vitamin D insufficiency (20-30 ng/ml). Of all students, only 7.1% (4 women, 11 men) had normal vitamin D levels and 56% had vitamin D deficiency (Table 3).

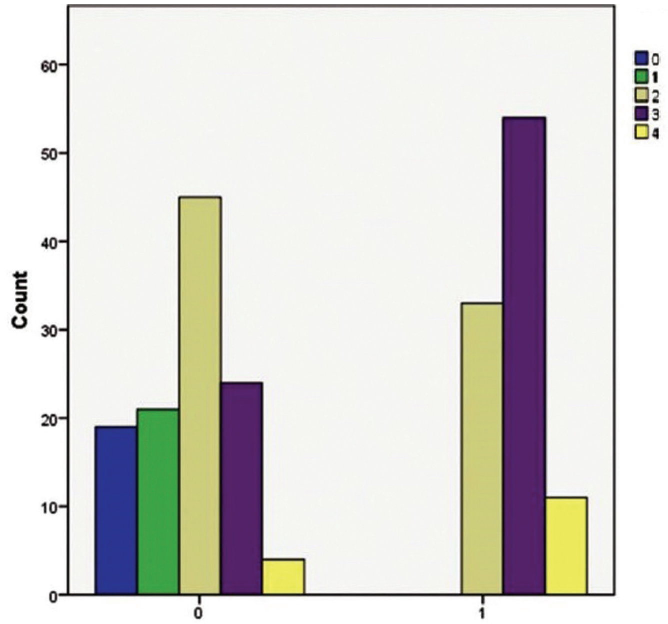

Figure 2. Distribution according to gender and vitamin D levels (0= women, 1= men and Blue= Severe Vitamin D deficiency; <5ng/ml, Green= Moderate vitamin D deficiency; 5-9.9 ng/ml, Cream= Mild vitamin D deficiency; 10-19.9 ng/ml, Purple= Vitamin D insufficiency; 20-30 ng/ml, Yellow= Normal vitamin D level; >30 ng/ml)

Table 3. Vitamin D levels and distribution according to gender

			Vitamin D levels					
			Severe vitamin D deficiency <5 ng/ml	Moderate vitamin D deficiency 5-9.9 ng/ml	Mild vitamin D deficiency 10-19.9 ng/ml	Vitamin D insufficiency 20-30 ng/ml	Normal vitamin D level >30 ng/ml	Total
Gender	Women	Count	19	21	45	24	4	113
		Expected	10.2	11.2	41.8	41.8	8.0	113.0
		% within gender	16.8%	18.6%	39.8%	21.3%	3.5%	100.0%
	Men	Count	0	0	33	54	11	98
		Expected	8.8	9.8	36.2	36.2	7.0	98.0
		% within gender	0.0%	0.0%	33.7%	55.1%	11.2%	100.0%
Total		Count	19	21	78	78	15	211
		Expected	19,0	21.0	78.0	78.0	15.0	211.0
		% within gender	9.0%	10.0%	37.0%	37.0%	7.1%	100.0%

DISCUSSION

Vitamin D deficiency is common in most of the industrialized and modernized Global North countries (8). Vitamin D deficiency is now recognized as a global pandemic (5). The worldwide prevalence of Vitamin D deficiency is relatively high (9,10). In the winter months, the prevalence of Vitamin D deficiency and insufficiency further increase (11). However, although the sun exposure is considered to be related to the geographic location, the ratios of vitamin D deficiency reaches to 39% even in subtropical regions receiving intensive sunlight (12). In the study performed in England, vitamin D deficiency and severe vitamin D deficiency were detected in 50% and 16% of the adult population in winter and spring semesters, respectively (8).

The prevalence of vitamin D deficiency is high in Turkey, as well (9). Ucar et al. performed a study in Ankara region recently and they reported high levels of vitamin D deficiency (51.8%) in their study (10). The ratios of vitamin D deficiency is also high in Turkish population in Europa (11). In most of the studies, as the values below 20 ng/ml (<50 nmol/l) is defined as deficiency, the prevalence varies in the range of 29-90% in adult Turkish population (11). Turkey has been accepted as endemic for vitamin D deficiency (12). In a multicenter study involving Erzurum and Van located on 41˚ East and 39˚ North, immunoassay was performed to detect 25 hydroxyvitamin D levels and the findings were relatively low on December and January (4.7±2.6 ng/ml) (13). When the levels were evaluated in different seasons and cut off value was accepted a 20 ng/ml, the ratio of deficiency was increased to 86% in winter, which was 24% in summer respectively (13). In a large-scaled study involving 2,488 adults, both seasonal variation and severe deficiency were detected (14). In a small-scaled study involving 391 individuals, a statistically significant relationship was reported between cloths and deficiency (15). In TURDEP-II study, which was the most large-scaled study conducted in Turkey, a total of 9,560 adults were examined from rural and urban areas, and 93% had vitamin D levels below 20 ng/ml (15).

The main source of vitamin D in human body is cholecalciferol (vitamin D3) that is formed during exposure to sunlight, 7-dehydrocholesterol in the skin absorbs UV-B radiation. The factors effecting 25-hydroxyvitamin D3 levels, independently of UV-B, are age, gender, body mass index (BMI), diet, physical activity, disease, drugs, skin color and genetic factors (16).

Nowadays, the living conditions of humans has been changed by means of the noticeable impacts of urbanization and modernization on our social life. One of them is the higher rates of time spent indoors.

The incidence of vitamin D deficiency is considered to be closely associated with this condition (16). In a cross-sectional study including 538 Netherlander in Netherlands, named as Hoorn study, a directly proportional relationship was revealed between the frequency of spending time outdoors and vitamin D levels (17).

Vitamin D supplementation is added to some staples (milk, butter, etc.) in USA and North European Countries (18).

Moreover, social awareness regarding vitamin D deficiency has been substantially increased in Northern Countries through national campaigns that were performed due to the high incidence of rickets in the past. In these countries, the high socioeconomic levels, the significant place of fish in their food culture and white skin color might be result of high vitamin D levels in comparison to other countries.

In the present study, the ratio of vitamin D deficiency was 55.9% when the cut off value was taken as 20 ng/ml, and women had more of a tendency to have deficiency. When the ratios of vitamin D deficiency was added to this finding, 92.9% of the students had vitamin D deficiency or insufficiency. Statistical significance level of p value was detected as <0.05. This ratio is compatible to those of large-scaled studies performed in Turkey. We took samples only in autumn. The province of Malatya, where the study has been conducted, is located at the 38º north latitude of Northern Hemisphere. The high ratios of serum vitamin D deficiency and insufficiency in our study gave rise to though that geographical location of the province, the level of urbanization and the season of which the measurements were done were effective on the results. As a geographical location, the distance to equator and seas reduces sunlight exposure, and socio-culturally affects life modes, dressing style and diet.

Socioeconomically, the low-income profile and poor diet are also among the factors influencing vitamin D levels. It is not adequately known that the lack of dietitian control of the diets for medical faculty students might cause vitamin D deficiency or insufficiency in Turkey. As in the developed countries, the lack of products enriched with vitamin D contributes to the deficiency in oral intake. Dietary habits have been changed with urbanization and modern life style. Dietary products, such as egg and dairy products, give their place to the fast food and starch products in the breakfast of students leaving their family life. Thus, it results in the reduced consumption of dietary products enriched in vitamin D(19).

Life styles have been changed with urbanization and modernization. The increasing numbers of shopping malls, sport centers, swimming pools, transportation vehicles and streets blocking sunlight with urbanization and modernization affect our daily life and block sun exposure. Teaching the lessons in sunless classrooms and the presence of study halls in sunless rooms result in reduced sun exposure for students who spend most of their time in classrooms and study halls.

Similar to other studies, the mean values of vitamin D levels of men and women were measured as 23.78 ng/ml (p<0.001) and 15.13 ng/ml (p=0.003), respectively. Both results were statistically significant. The reduced vitamin D levels in women was compatible to other studies performed in Turkey.

CONCLUSION

Our study findings reflect the characteristic features of the Turkish population. As globally, Vitamin D deficiency or insufficiency appears as a common problem with urbanization and modernization in Turkey, as well. Urbanization should be reviewed, social awareness should be provided, and modernization should be correctly comprehended and inhabited to solve this issue. The ratios of Vitamin D deficiency or insufficiency can lowered by low-cost preventive health services. It might provide a significant contribution to both our personal and social health, and economy.

REFERENCES

1. Spiro A, Buttriss JL. Vitamin D: an overview of vitamin D status and intake in Europe. Nutr Bull 2014;39(4):322-50.
2. Bringhurst FR, Demay MB, Krane SM, Kronenberg HM. Bone and Mineral Metabolism in Health and Disease. In: Kasper DL, Braunwald E, Fauci AS, Hauser SL, Longo DL, Jameson JL, editors. Harrison's Principles of Internal Medicine. 16th edition. New York:MCGraw-Hill Companies; 2005. p. 2238-86.
3. Holick MF. Vitamin D: a D-lightful health perspective. Nutr Rev 2008;66(10 Suppl):182-94.
4. Hyppönen E, Boucher BJ, Berry DJ, Power C. 25-hydroxyvitamin D, IGF-1, and metabolic syndrom at 45 years of age: a cross-sectional study in the 1958 British Birth Cohort. Diabetes 2008;57(2):298-305.
5. Wacker M, Holick MF. Vitamin D-Effects on Skeletal and Extraskeletal Health and the Need for Supplementation. Nutrients 2013;5(1):111-48.
6. Öngen B, Kabaroğlu C, Parıldar Z. D Vitamini'nin Biyokimyasal ve Laboratuvar Değerlendirmesi. Türk Klinik Biyokimya Dergisi 2008;6(1):23-31.
7. Holick MF, Binkley NC, Bischoff-Ferrari HA, Gordon MC, Hanley DA, Heaney RP, et al. Evaluation, treatment, and prevention of vitamin D deficiency: an endocrine society clinical practice guideline. J Clin Endocrinol Metab 2011;96(7):1911-30.
8. Pearce SHS, Cheetham TD. Diagnosis and management of vitamin D deficiency. BMJ 2010;340:b5664.
9. Uçar F, Taşlıpınar MY, Soydaş AÖ, Özcan N. Ankara Etlik İhtisas Eğitim Araştırma Hastanesi'ne Başvuran Hastalarda 25-OH Vitamin D Düzeyleri. Eur J Basic Med Sci 2012; 2(1):12-5.
10. Sahota O, Mundey MK, San P, Godber IM, Lawson N, Hosking DJ. The relationship between vitamin D and parathyroid hormone: calcium homeostasis, bone turnover, and bone mineral density in postmenopausal women with established osteoporosis. Bone 2004;35(1):312-9.
11. Lips P. Vitamin D deficiency and secondary hyperparathyroidism in the elderly: consequences for bone loss and fractures and therapeutic implications. Endocr Rev 2001;22(4):477-501.
12. Hollis, BW. Assessment and interpretation of circulating 25-hydroxyvitamin D and 1, 25-dihydroxyvitamin D in the clinical environment.Endocrinol Metab Clin North Am 2010;39(2):271-86.
13. Bozkurt S, Alkan B, Yildiz F, Gumus S, Sezer N, Ardıçoglu O, et al. Age, Sex, and Seasonal Variations in the Serum Vitamin D3 Levels in a Local Turkish Population. Turkish Journal of Rheumatology 2014;29(1):14-19.
14. Aypak C, Turedi O, Yuce A. The association of vitamin D status with cardiometabolic risk factors, obesity and puberty in children. Eur J Pediatr 2014;173(3):367-73.
15. Halicioglu O, Aksit S, Koc F, Akman SA, Albudak E, Yaprak I, et al. Vitamin D deficiency in pregnant women and their neonates in spring time in western Turkey. Paediatr Perinat Epidemiol 2012;26(1):53-60.
16. Ginde AA, Liu MC, Camargo CA Jr. Demographic differences and trends of vitamin D insufficiency in the US population, 1988-2004. Arch Intern Med 2009;169(6):626-32.
17. Holick MF. The vitamin D deficiency pandemic: a forgotten hormone important for health. Public Health Reviews 2010;32(1):267-83.
18. Mithal A, Wahl D, Bonjour J, Burckhardt P, Dawson Hughes B, Eisman JA, et al. Global vitamin D status and determinants of hypovitaminosis D. Osteoporos Int 2009;20(11):1807-20.