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Original Article

Relation of vitamin D levels with sunlight, genetics and nutrition

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Abstract

Aim: We aimed to reveal the effects of reduced exposure to sunlight and insufficient nutrition due to urbanization and altered cultural life on Vitamin D levels in medical students.

Materials and Methods: A hundred (56 female, 44 male) first year medical students were included in our study. A vitamin D screening form, which included 16 questions, was used to obtain data regarding medical students' genetic, nutrition and cultural life.

Results: Out of 100 medical students, 25 hydroxyl vit- D3 levels was below 5 ng/ml in 10%, 5-10 ng/ml in 10%, 10-20 ng/ml in 30%, 20-30 ng/ml in 40% and above 30 ng/ml in 10% medical students. While it has been found out that urbanization causes vitamin D deficiency and insufficiency in both females and males by negatively affecting sunlight exposure and nutrition, females have less sunlight exposure and their vitamin D levels are lesser when compared with males.

Conclusions: In conclusion, urbanization decreases exposure to sunlight and changes nutritional habits and forms a basis for vitamin D deficiency. So, this shows that lack of vitamin D, which is a major cause of bone fractures in older ages, is actually mainly seen in younger ages.

Keywords: Vitamin D; Sunlight; Nutrition; Cultural Life; Aging.

INTRODUCTION

Vitamin D is a steroidal hormone among the fat soluble vitamins which is both synthesized in the body and which could be taken in the diet (1). The most important effect in the body is on the musculoskeletal system. While regulating calcium and phosphorus metabolism, it demonstrates its effect on bone, kidney and parathyroid glands (2). In recent studies, it has been demonstrated that in addition to the effects on the musculoskeletal system, vitamin D is associated with many cancers, cardiovascular diseases, metabolic syndrome, infectious diseases, autoimmune diseases, allergic diseases, depression and cognitive status (3,4) Thus, sufficient dietary intake of vitamin D is vital to general health status in addition to the musculoskeletal system (5).

Very important vitamin D supply is endogenously synthesized vitamin D. Vitamin D which is taken in the diet could not meet the body requirements alone (6). Hence, the main supply to meet the vitamin D requirement is the sun (7). When we sufficiently benefit from sunlight, there is no need to take additional vitamin D. Cholecalciferol (vitamin D3) is synthesized in dermis and epidermis from 7 dehydrocholesterol which is an intermediate metabolite in cholesterol synthesis (8). It is taken in the form of ergocalciferol (vitamin D2) from vegetables in the diet or in the form of cholecalciferol in the animal tissues. Vitamin D is mostly found in fish, liver and egg yolk. Vitamin D2 and vitamin D3 are biologically inactive (8). For activation, it should be converted to 25 hydroxy vitamin D [25(OH)D] in the liver by 25 hydroxylase enzymes, and then, to 1,25 dihydroxy vitamin D [1,25 (OH) 2D] in kidneys by 1 alpha hydroxylase enzyme (2,8). Active vitamin D demonstrates its effect by binding to intracellular receptors in the small intestine, kidney, brain, lung, colon, immune system and tumor cells. 1,25 (OH)2 vitamin D is inactivated by 24 hydroxylase enzymes and excreted in bile (8).

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It is necessary to measure 25 (OH) vitamin D level to determine vitamin D level in individuals because the active form 1.25 (OH)2 vitamin D is not convenient for measurement. While the half-life of active form is 4-6 hours, half-life of 25 (OH) vitamin D is 2-3 weeks, and its serum concentration is 1.000 fold more than the active form (9). In the report published by World Health Organization in 2003, serum level of 25 (OH) vitamin D below 10 ng/ml was defined as deficiency and 11-20 ng/ml was defined as insufficiency (10). Rickets, osteomalacia and osteoporosis and increased risk of fracture depending on these are observed in vitamin D deficiency (11,12).

So our purpose in this study we wanted to attention to the lack of vitamin-D that could come into contact with insufficient sunlight.

MATERIAL and METHODS

After taking necessary permissions (patients consent form, 114 medical students at the first year in our university's medical faculty were included in this study, three students were excluded as they had a disease-that caused vitamin D deficiency and also 11 students were excluded as they were under vitamin D treatment. This study was conducted with 100 students in 2017 year. All of the subjects included in this study were healthy individuals aged between 17 and 29 (mean age was 19.38). Individuals who had diseases that caused vitamin D deficiency (e.g. liver disease, renal disease), use drugs interacting with vitamin D metabolism (e.g. anticonvulsants, glucocorticoids), have metabolically increased vitamin D requirement (e.g. pregnant, breastfeeding) and had previously taken vitamin treatment (e.g. ricketsia, osteomalacia) were were excluded from study. Questions regarding age, gender, height, weight of the individuals, and whether they have any diseasethat cause vitamin D deficiency or not, whether they use any drug interacting with vitamin D or not, whether they took vitamin D therapy previously or not were asked to choose participants. And also, a vitamin D questionnaire form that was composed of 16 questions was used to collect data (Table 1). Medical students' blood samples were obtained, and they were examined at the same laboratory on the same day.

Statistical Analysis

SPSS program was used to analyse data. While providing descriptive statistics, data were summarized as frequency distribution in the presentation of qualitative data and as the arithmetic mean, minimum, maximum and standard deviation in the presentation of quantitative data. Non-parametric tests and the chi-square test were used in the analysis of qualitative data and parametric tests were used in normally distributed quantitative data and non-parametric tests were used in analysis of quantitative data which was not normally distributed. Chi-square test, independent student t-test and Mann-Whitney U test were used in analysis of data. Significance value was accepted as $p \leq 0.05$.

RESULTS

Mean age of participants (56 female, 44 male) was 19.38 (17-29). Mean body mass index was 22.5 (16.5-29.7) and mean serum vitamin D level was 19.06 (0.10-83.97) (Table 2). Participants datas' conducted from answer to our questionare were summarized in Table 1.

Table 1. Data of questionnaire form related to vitamin D

Vitamin D level:	Age:	Gender:
Body mass index:	Height:	Weight:
Survey questions	Yes	No
Do you have any disease-causing vitamin D deficiency?	3	111
Do you use any drug causing vitamin D deficiency?	0	114
Have you received vitamin D therapy?	11	103
1. Do you have any person taking vitamin D therapy in your family?	15	85
2. Have you born in spring or summer months?	51	49
3. Have you lived in village or coastal city?	30	70
4. Do you swim and/or have sunbathing?	63	37
5. Do you wear white clothes?	69	31
6. Do you have activity under the sun longer than 1 hour every week?	68	32
7. Do you use sun cream?	54	46
8. Are you light skinned?	69	31
9.Do you do diet?	25	75
10.Do you consume fish every week?	16	84
11.Do you consume egg every week?	64	36
12.Do you consume milk products every week?	77	23
13.Do you consume potatoes every week?	68	32
14. Do you consume oat every week?	8	92
15. Do you consume liver every week?	4	96
16. Do you consume mushroom every week?	2	98

Table 2. Data according to vitamin D level

Vitamin D level	Severe deficiency 0-5 ng/ml	Moderate deficiency 5-10 ng/ml	Mild deficiency 10-20 ng/ml	Vitamin D insufficiency 20-30 ng/ml	Vitamin D normal value >30 ng/ml	Total number of students
	10	10	30	40	10	100
Female	10	10	20	12	4	66
Male	0	0	10	28	6	44
Mean body/mass index	22.7	21.1	22.8	22.8	21.5	22.5

Vitamin D deficiency was more commonly seen and severe in females and this was found to be statistically significant ($p<0.001$). There was no correlation between vitamin D level and body/mass index ($p=0.800$). No statistically significant correlation was found between light skin or dark skin and vitamin D deficiency ($p=0.338$). No statistical significance was found between the season of birth and vitamin D deficiency ($p=0.629$). We found that vitamin D deficiency was not statistically significant in students who have individuals in the family that were under therapy for vitamin D deficiency ($p=0.345$)

When the individuals wore dark clothes and the individuals wore white clothes and increased the skin surface exposed to sunlight were compared, vitamin D deficiency was significantly more common in the first group ($p<0.01$). We found out that there was no statistically significant difference regarding vitamin D deficiency between the students who performed activity under sunlight for longer than 1 hour for at least 1 day in a week and the students who did not perform any activity ($p=0.236$). There was statistically significant difference between the individuals who performed swimming and sunbathing and the individuals who did not perform these activities ($p<0.001$). No correlation was found in terms of vitamin D deficiency between the individuals who used sun cream and the individuals who did not use sun cream ($p=0.455$).

DISCUSSION

Vitamin D deficiency and insufficiency is widely seen in Turkey also, similar to the world (13-17). Turkey is one of the countries that vitamin D deficiency is endemic (18). Vitamin D deficiency is accepted as a global epidemic now (19). When compared with the summer months as sun exposure decreases in winter months, vitamin D levels decrease more and more (20). Severe vitamin D deficiency (<5 ng/ml) causes rickettsia in children and osteomalacia in adults (21,22). In recent years, vitamin D deficiency and insufficiency are associated with several chronic diseases (such as cancers, cardiovascular diseases, autoimmune diseases, infectious diseases, metabolic syndromes, psychiatric diseases, type 2 diabetes mellitus) (21,23).

In the literature, most commonly insufficient sun-skin contact is shown as etiology of vitamin D deficiency and nutrition, diseases, physiological periods where the requirement is increased and vitamin D deficiency in mother are also suggested as etiological factors.

If there was no known disease, during newborn period vitamin D deficiency is most commonly observed in individuals who were born from vitamin D deficient mothers or in individuals who were born in autumn/winter months and had delayed exposure to sun. By including these two conditions which take place during newborn period into the study, we aimed to reveal whether this has any effects during young adult period or not. No statistical significance was found between the season of birth and vitamin D deficiency ($p=0.629$). We found that vitamin D deficiency was not statistically significant in students who have individuals in the family that were under therapy for vitamin D deficiency ($p=0.345$). Furthermore, we found that there was no statistically significant difference in terms of vitamin D deficiency between living in places where exposure to sun is increased, such as countryside or costal region, for more than 1 year since birth and continuously living in urban area ($p=0.586$).

The main vitamin D source in the body is the photochemical formation of cholecalciferol (vitamin D3) from 7 dehydrocholesterol by the effects of ultraviolent B light. Excess exposure to sunlight turns vitamin D3 to inactive products. It could be taken as both herbal ergocalciferol (vitamin D2) and animal cholecalciferol (vitamin D3). Vitamin D which is taken in excess amounts in the diet could be stored in fat cells (19,24).

Vitamin D deficiency was found to be statistically more common in individuals who did diet when compared with the individuals who did not do diet ($p=0.003$). We found that there was no correlation between vitamin D deficiency and nutrition with food rich in vitamin D. Although fish consumption is low in Malatya due to continental climate, egg yolk and milk products are consumed much. Oat, liver and mushroom are consumed in low amounts. While only three students stated that they did nott consume any of these food weekly, two of them were female and one was male and vitamin D level was not at the level of deficiency in any of them. It was at the level of insufficiency in three of them. Vitamin D deficiency was more in individuals doing diet because none of the diets were under control of a dietician. Most of the individuals who were doing diet were females: 76% (19 females) and 24% (6 males). There was severe deficiency in 24% (6 females), moderate deficiency in 16% (4 females) and mild deficiency in 28% (4 females, 3 males) and insufficiency in 28% (4 females, 3 males) of the individuals who were doing diet.

We analyzed parameters related to sun and diet according to gender. As vitamin D deficiency was significantly high in females, when analyzed again, we found out that some parameters were statistically significant. Vitamin D deficiency was less in females who were performing activities, such as swimming and sunbathing, when compared with the females who never performed these activities and there was statistically high significance ($p<0.001$). Vitamin D deficiency was more common in females who used sun cream when compared with the females who did not use sun cream, and this was statistically significant ($p=0.033$). There was no correlation between gender and activity under sunlight. There was statistically significant correlation between female gender and wearing ($p<0.001$). The findings showed that there was a correlation between female gender and diet with a significance level as $p=0.055$.

In the present study, vitamin D levels were assessed as severe deficiency <5 ng/ml), moderate deficiency (5-9.99 ng/ml), mild deficiency (10-19.99 ng/ml) insufficiency (20-29.99 ng/ml) and normal (>30 ng/ml); and the cut off value was accepted a 20 ng/ml and the individuals with vitamin

D deficiency were further evaluated. As seen in Table 2, it has been found that vitamin D levels were lower in females when compared with males and especially all students who had severe and moderate deficiency were females and most of the students who have mild deficiency were also females. While no severe and moderate deficiency was observed in males, mild deficiency was seen in only 22.7% (10 individuals) of males. All of the students with severe and moderate deficiency (below 10 ng/ml) were female students (20 females); 95% of these (19 students) were using kerchief and 65% (13 students) were using sun cream, 85% (17 students) never performed activities, such as swimming and sunbathing, within a year and 50% (10 students) had diet time to time and these factor may explain the low levels of vitamin D in these students.

CONCLUSION

As a result of measurement of serum vitamin D levels in the medical students who participated in this study, we found out that there was a severe deficiency in 10%, moderate deficiency in 10% and mild deficiency in 30%. There was vitamin D insufficiency in 40% of the students. We think that urbanization decreases exposure to sunlight and changes nutritional habits and forms a basis for vitamin D deficiency. And for dressing styles especially among female subjects; closed-wear apparel that reduces sunlight exposure. Findings showed that vitamin D deficiency was more frequent in females when compared with males. So, this shows that lack of vitamin D, which is a major cause of bone fractures in older ages, is actually mainly seen from younger ages.

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REFERENCES

1. Quach A, Levine ME, Tanaka T, et al. Epigenetic clock analysis of diet, exercise, education, and lifestyle factors. Aging (Albany NY) 2017;9:419-46.
2. Sevimli R, Yakıncı C, Encan ME, et al. The Prevalence of Vitamin D Deficiency-Insufficiency in Medical Faculty Students. J Turgut Ozal Med Cent 2018;25:10-6.
3. Holick MF. Vitamin D: importance in the prevention of cancers, type 1 diabetes, heart disease and osteoporosis. Am J Clin Nutr 2004;79:362-71.
4. Holick MF. Sun light and vitamin D for bone health and prevention of autoimmune diseases, cancer and cardiovascular disease. Am J ClinNutr 2004;80:1678-88.
5. Holick MF, Chen TC. Vitamin D deficiency: a worldwide problem with health consequences. Am J Clin Nutr 2008;871080-6.
6. Yılmaz M, Yılmaz N. The role of vitamin D in the brain and related neurological diseases. J Clin ExpInvest 2013;4:411-15.
7. Layec G, Trinity JD, Hart CR, et al. Evidence of a metabolic reserve in the skeletal muscle of elderly people. Aging (Albany NY) 2017;9:52-67.
8. Boccardi V, Paolisso G, Mecocci P. Nutrition and lifestyle in healthy aging: the telomerase challenge. Aging (Albany NY) 2016; 8:12-15.
9. Konradsen S, Ag H, Lindberg F, et al. Serum 1,25-dihydroxy vitamin D is inversely associated with body mass index. Eur J Nutr 2008;47:87-91.
10. WHO Scientific Group on the Prevention and management of osteoporosis. Prevention and management of osteoporosis: report of a WHO scientific group. Geneva: World Health Organization, 2003.
11. Binkley N, Ramamurthy R, Krueger D. Low vitamin D status: definition, prevalence, consequences and correction. Endocrinol Metab Clin North Am 2010;39:287.
12. Stechschulte SA, Kirsner RS, Federman DG. Vitamin D: bone and beyond, rationale and recommendations for supplementation. Am J Med 2009; 122:793-802.
13. Ginde AA, Liu MC, Camargo CA. Demographic differences and trends of vitamin D insufficiency in the US population, 1988-2004. Arch Intern Med 2009; 169:626-32.
14. Bozkurt S, Alkan B, Yildiz F, et al. Age, Sex, and Seasonal variations in the serum vitamin D3 levels in a local Turkish population. Turkish J Rheumatol 2014;29:14-19.
15. Sahota O, Mundey MK, San P, et al. The relationship between vitamin D and parathyroid hormone: calcium homeostasis, bone turnover, and bone mineral density in postmenopausal women with established osteoporosis. Bone 2004;35:312-9.
16. Aypak C, Türedi Ö, Yüce A. The association of vitamin D status with cardiometabolic risk factors, obesity and puberty in children. Eur J Pediatr 2014;173:367-73.
17. Halicioglu O, Aksit S, Koc F, et al. Vitamin D deficiency in pregnant women and their neonates in spring time in western Turkey. Paediatr Perinat Epidemiol 2012;26:53-60.
18. Ozkan B, Doneray H, Karacan M, et al. Prevalence of vitamin D deficiency rickets in the eastern part of Turkey. Eur J Pediatr 2009;168:95-100.
19. Wacker M, Holick MF. Vitamin D-Effects on Skeletal and Extraskeletal Health and the Need for Supplementation. Nutrients 2013;5:111-48.
20. Lips P. Vitamin D deficiency and secondary hyperparathyroidism in the elderly: consequences for bone loss and fractures and therapeutic implications. Endocr Rev 2001;22:477-501.
21. Lips P. Vitamin D status and nutrition in Europe and Asia. J Steroid Biochem Mol Biol 2007;103:620-5.
22. Olson ML, Maalouf NM, Oden JD, et al. Vitamin D deficiency in obese children and its relationship to glucose homeostasis. J Clin Endocrinol Metab 2012;97:279-85.
23. Holick MF. Vitamin D: D-lightful health perspective. Nutr Rev 2008;66:182-94.
24. Hyppönen E, Boucher BJ, Berry DJ, et al. 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;57:298-305.