

Evaluation of the Prevalence of Vitamin D Deficiency and its' Correlation with Body Mass Index and Waist Circumference in Children

Marzie Fatemi Abhari^{*}

Department of Pediatrics, Alborz University of Medical Sciences, Karaj, Iran

ABSTRACT

Introduction: Recent studies have suggested a link between vitamin D deficiency and an increase in body mass index and waist circumference. The aim of this study was to evaluate the vitamin D status and its' correlation with body mass index and waist circumference in children aged 2-14 referred to the clinic of Imam Ali Hospital in Karaj in 2019-2020.

Methods: Three Hundred seventy-nine (379) children aged 2-14 years referred to Clinic were enrolled in the study. Patients' height, weight (BMI calculated accordingly), waist circumference and serum vitamin D levels were measured. Chi-Square, Krystal-Wallis and Fishers exact tests were used, and the Bivariate Correlation test was used to determine the relationship between two variables.

Results: The prevalence of vitamin D deficiency, insufficiency and adequate levels were reported 40.6%, 11.9% and 47.5%, respectively. Vitamin D deficiency was more common in girls. Vitamin D had a significant and weak relationship with BMI, but no association with waist circumference.

Conclusion: The results of this study showed a high prevalence of vitamin D deficiency in patients. The prevalence of vitamin D deficiency and insufficiency were higher in girls. The highest levels of vitamin D were found in patients with normal weight. Vitamin D deficiency was most common in obese patients. Serum vitamin D were significantly associated with obesity, but had no significant association with waist circumference. A study with a larger sample size in this area, is recommended.

Keywords: Vitamin D; Children; Body mass index; Waist circumference

INTRODUCTION

Vitamin D plays an important role in bone growth, bone mineralization and other metabolic processes in the human body such as calcium and phosphorus homeostasis [1-3]. Vitamin D deficiency has been a major health issue at all stages of life, but it is more common in childhood due to poor diet and poor skin synthesis [4]. The main natural source of this vitamin is the synthesis of D3 from cholesterol through a chemical reaction associated with the sun's ultraviolet rays on the skin [5-7]. Vitamin D Receptor (VDR) belongs to the family of steroid/thyroid hormone intranuclear receptors, which are expressed by cells of most organs, including the brain, heart,

skin, glands, prostate, and breast. With the discovery of vitamin D receptors in most tissues and cells of the body, a new insight has been created towards vitamin D [8]. Recent studies have recently reported that, in addition to skeletal effects such as maintaining normal bone regeneration, mineralization during adulthood and prevention of rickets in children, vitamin D deficiency is involved in many chronic diseases such as obesity, hypertension, cardiovascular disease, diabetes. Mellitus, metabolic syndrome, autoimmune and inflammatory diseases and some cancers [9]. In a meta-analysis conducted in Iran, the prevalence of vitamin D deficiency was reported 31% in children and adolescents [10]. Inadequate vitamin D status can be a risk factor for obesity in children. Currently, obesity is the most

Correspondence to: Marzie Fatemi Abhari, Department of Pediatrics, Alborz University of Medical Sciences, Karaj, Iran, E-mail: m.fatemi@abzums.ac.ir

Received: August 23, 2021; Accepted: September 06, 2021; Published: September 13, 2021

Copyright: © 2021 Abhari MF. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Citation: Abhari MF (2021) Evaluation of the Prevalence of Vitamin D Deficiency and its' Correlation with Body Mass Index and Waist Circumference in Children. J Clin Toxicol. S19:002.

common nutritional disease among Iranian children and adolescents [11,12]. Vitamin D, through its role in regulating intracellular calcium concentration, affects lipolysis [13,14] and adipogenesis [15,16] in the adipocytes. Studies in different countries have examined the link between vitamin D status and obesity. In a study conducted by Nevestani and colleagues in Tehran on 11 children aged 9-11 years old, serum vitamin D was inversely related to body mass index [17]. A study by Cizmecioglu and colleagues in Turkey on 301 boys and girls aged 11-19 years old showed that serum vitamin D levels decreased with increasing BMI [18]. Dong and colleagues examined the relationship between serum vitamin D status and obesity in American adolescents and found a significant association between serum vitamin D and abdominal obesity [19]. However, the results of the studies are not entirely uniform. In Delvin and Muhairi's studies of 9-13 years old Canadian girls and boys and 15-18 years old boys and girls in the United Arab Emirates, respectively, no significant association was found between serum vitamin D and BMI [20]. Considering the importance of identifying the prevalence of vitamin D deficiency in children and its relationship with obesity, for medical and preventive policies and lack of sufficient information in this field in Alborz province and Karaj city, this study examines the prevalence of vitamin D deficiency and its relationship with the body mass index and waist circumference in children aged 2 to 14 years, referred to Karaj's Imam Ali Hospital clinic in 2019-2020.

MATERIALS AND METHODS

This study is a cross-sectional and descriptive-analytical study conducted in Karaj's Imam Ali Hospital clinic in 2019-2020. Inclusion criteria included age between 2-14 years, absence of major medical conditions such as heart disease, hepatitis, kidney disease, gastrointestinal and cancer, and not taking any medication or nutritional supplement such as calcium and vitamin D over the past month. Parental dissatisfaction with participating in this study was considered as an exclusion criterion. Three hundred seventy-nine (379) children referred to the clinics of Imam Ali Hospital in Karaj were selected by easy (available) selection method and entered the study in three age groups of 2 to 6 years, 6 to 12 years and 12 to 14 years. At the beginning, the researcher explained the plan to the parents and asked them to complete the written questionnaire form if they were satisfied to participate in the study. Parents are then asked to answer questions from the demographic questionnaire, which includes information on age and gender. Body weight was measured using a scale with an accuracy of 0.5 kg. Children weighed without shoes and with light clothes. The height was measured standing on a flat surface without shoes and with an accuracy of 0.5 cm using a height gauge. Measurement and recording of height and weight was done by a fixed person. Body mass index was calculated for all samples. Then, according to the body mass index definitions of the Centers for Disease Control and Prevention (CDC), the following individuals were divided into different groups based on sex and age: less than 5 percentiles as low weight, between 5 and 85 percentiles as normal weight, between 85 and 95 percentiles as overweight, and more than 95 percentiles as obese. Waist circumference was

measured from the lowest diameter area between the lower edge of the chest and the anterior superior iliac spine with a nonelastic meter with an accuracy of 0.1 cm. In order to assess the serum level of the body's vitamin D, intravenous blood sampling was done for all individuals using the EIA kit. According to the International Endocrine Association's guidelines for vitamin D, serum vitamin D less than 20 ng/ml was considered as deficiency, between 21 and 29 ng/ml as insufficiency, and more than 30 ng/ml as normal level.

Statistical analysis

We analyzed the obtained data using SPSS software version 22. Chi-Square, Kruskal-Wallis and Fishers exact tests were used, and the Bivariate Correlation test was used to determine the relationship between two variables. The p value less than 0.05 was considered to be significant, and the results were presented as a mean and standard range.

RESULTS

In this study, among 379 cases were split into 3 groups based on their age; 133 patients (35.1%) were in the age group of 2 to 6 years, 199 patients (52.5%) in the age group of 6 to 12 years and 47 patients (12.4%) in the age group of 12 to 14 years. In terms of gender, 171 patients (45.1%) were boys and 208 patients (54.9%) were girls. according to the Body Mass Index (BMI) status, 17.2% of patients were overweight and 7.9% of them were obese. 40.6% of children had vitamin D deficiency and 11.9% had vitamin D insufficiency. 52.9% of girls were deficient in vitamin D, compared with 25.7% of boys. In the following, the status of vitamin D in patients was examined according to age groups, but there was no significant difference between them. There was a significant and inverse relationship between serum vitamin D levels and body mass index. The mean waist circumference (WC) of the patients was examined according to the vitamin D status and no significant correlation was observed between them (Table 1).

		Vitamin D deficien cy (N=154)	Vitamin D insuffici ency (N=45)	Vitamin D sufficie ncy (N=180)	Total (N=379)	P-value
Sex	Female	110 (52.9%)	31 (14.9%)	67 (32.2%)	208 (100%)	0.000
	male	44 (25.7%)	14 (8.2%)	113 (61.1%)	171 (100%)	
Age	Pre- school	61 (45.9%)	14 (10.5%)	58 (43.6%)	133 (100%)	0.130
	School	80 (40.2%)	27 (13.6%)	92 (46.2%)	199 (100%)	
	Adolesc ence	13 (27.7%)	4 (8.5%)	30 (63.8%)	47 (100%)	

BMI	underw eight	3 (33.3%)	2 (22.2%)	4 (44.4%)	9 (100%)	0.001
	normal	95 (34.5%)	34 (12.4%)	146 (53.1%)	275 (100%)	
	Overwei ght/ obese	56 (58.9%)	9 (9.5%)	30 (31.6%)	95 (100%)	-
Waist circumference		67.53 (10.29)	68.34 (11.62)	68.14 (11.79)	67.92 (11.16)	0.78

Table 1: Demographic and anthropometric measures of the study population based on Vitamin D status; continuous and categorical variables are presented as mean (SD) and N (%), respectively.

DISCUSSION

The aim of this study was to determine the prevalence of vitamin D deficiency and its relationship with body mass index and waist circumference in children aged 2 to 14 years who referred to the clinic of Imam Ali Hospital in Karaj in 1398. 379 patients were examined. According to studies, most overweight and obese children and adolescents live in economically developed countries.

Obesity in American children and adolescents increased dramatically between 1999 and 2016 (from 10.7% to 13.7% in children and from 16.6% to 20.6% in adolescents) [21]. According to a meta-analysis conducted in 2017, the prevalence of obesity in Iranian students was reported to be 5.82%, which was higher in boys than girls [22]. In the present study, the prevalence of overweight and obesity was 17.2 and 7.9 percent, respectively, and this rate was higher in boys than girls, but this difference was not significant, which could be due to the limited sample size in the present study. In this study, the prevalence of vitamin D deficiency in patients was 40.6%, which is higher than the rate reported in meta-analysis performed. This is reported to be 31% [10]. On the other hand, in another study conducted in 2008 in Tehran, vitamin D deficiency in children and adolescents was 34.9%, which is lower than the current study [23]. In the present study, this rate was reported to be 40.6%. In this study, the prevalence of vitamin D deficiency and insufficiency in boys was significantly lower than in girls, and the results of previous studies confirm the results of the present study [10,23].

In this study, the highest normal level of vitamin D was observed in patients with normal weight and the lowest levels were observed in patients with obesity. On the other hand, the highest levels of vitamin D deficiency were seen in patients with obesity. In a study conducted in Russia in 2019, it was shown that the prevalence of vitamin D deficiency and insufficiency in patients with obesity and overweight is higher than people with normal weight [24] which confirms the results of the present study. In the present study, the correlation between patients' body mass index and vitamin D serum levels showed a weak and significant inverse relationship between the two variables. In this regard, a study conducted in 2018 in Iran showed that the prevalence of vitamin D deficiency and insufficiency is more common in children and adolescents with obesity and overweight than in normal weight people, but no correlation was found between obesity and serum vitamin D levels [25]. In the present study, the correlation between patients' waist circumference and serum levels of vitamin D showed a very weak and insignificant inverse relationship between the two variables. In this regard, in a study conducted in 2014 in Iran, a significant relationship was obtained between these two factors, which seem to be present due to the limitation in the sample size of this study [26].

CONCLUSION

According to this cross-sectional study, the prevalence of vitamin D deficiency and insufficiency in children aged 2-14 years referred to the clinic of Imam Ali Hospital were reported to be 40.6% and 11.9%, respectively. The results of the study showed that girls had more vitamin D deficiency than boys. In terms of body mass index percentage, a total of 25.1% of patients were obese and overweight. On the other hand, the highest rate of vitamin D deficiency and insufficiency was seen in obese patients and a weak and significant inverse relationship was observed between obesity/overweight and serum vitamin D levels, but no significant relationship was observed between waist circumference and serum vitamin D levels.

RECOMMENDATIONS

It is recommended that a case study be performed to examine the relationship between serum vitamin D levels and obesity/ overweight and waist circumference as a multicenter study with high sample size to determine the risk ratio.

ACKNOWLEDGMENT

We would like to thank the officials of the clinic and laboratory of Imam Ali Hospital in Karaj, as well as all the participants in this study and their parents who provided the opportunity to conduct this project.

CONFLICT OF INTEREST

None declared.

FUNDING

The authors received no funding from an external source.

ETHICAL APPROVAL

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was obtained from all individual participants included in the study.

OPEN ACCESS Freely available online

REFERENCES

- Tsiaras WG, Weinstock MA. Factors influencing vitamin D status. Acta Dermato-Venereologica. 2011;91(2):115-124.
- 2. Haroon M, Regan MJ. Vitamin D deficiency: the time to ignore it has passed. International J Rheumatic Diseases. 2010;13(4):318-23.
- Reid IR, Bolland MJ, Grey A. Effects of vitamin D supplements on bone mineral density: a systematic review and meta-analysis. Lancet. 2014; 383(9912):146-155.
- Pereira-Santos M, Costa PR, Assis AM, Santos CA, Santos DB. Obesity and vitamin D deficiency: a systematic review and metaanalysis. Obesity Reviews. 2015;16(4):341-349.
- 5. Kliegman RM, Behrman RE, Jenson HB, Stanton BM. Nelson Textbook of Pediatrics e-book: Elsevier Health Sciences; 2007.
- Palermo NE, Holick MF. Vitamin D, bone health, and other health benefits in pediatric patients. J Pediatric Rehabilitation Medicine. 2014;7(2):179-192.
- Misra M, Pacaud D, Petryk A, Collett-Solberg PF, Kappy M. Vitamin D deficiency in children and its management: review of current knowledge and recommendations. Pediatrics. 2008;122(2):398-417.
- Holick MF. Vitamin D: A millenium perspective. J Cell Biochem. 2003;88(2):296-307.
- 9. Zittermann AJBJoN. Vitamin D in preventive medicine: are we ignoring the evidence? Br J Nutr. 2003;89(5):552-72.
- Jazayeri M, Moradi Y, Rasti A, Nakhjavani M, Kamali M, Baradaran HR. Prevalence of vitamin D deficiency in healthy Iranian children: A systematic review and meta-analysis. Med J Islam Repub Iran. 2018;32(1):83.
- Maddah MJP. Overweight and obesity among Iranian female adolescents in Rasht: more overweight in the lower social group. Research Gate. 2007;10(5):450-453.
- Mohammadpour AB, Rashidi A, Karandish M, Eshraghian M, Kalantari NJPhn. Prevalence of overweight and obesity in adolescent Tehrani students, 2000-2001: an epidemic health problem. Public Health Nutr. 2004;7(5):645-8.
- Xue B, Greenberg AG, Kraemer FB, Zemel MB. Mechanism of intracellular calcium ([Ca2+]i) inhibition of lipolysis in human adipocytes. FASEB journal: official publication of the Federation of American Societies for Experimental Biology. FASEB J. 2001;15(13): 2527-9.
- 14. Zemel MB, Shi H, Greer B, Dirienzo D, Zemel PC. Regulation of adiposity by dietary calcium. FASEB J. 2000;14(9):1132-1138.

- Kong J, Li YC. Molecular mechanism of 1,25-dihydroxyvitamin D3 inhibition of adipogenesis in 3T3-L1 cells. American journal of physiology Endocrinology and metabolism. Am J Physiol. 2006;290(5):E916-24.
- Wood RJ. Vitamin D and adipogenesis: new molecular insights. Nutr Rev. 2008;66(1):40-46.
- Neyestani TR, Hajifaraji M, Omidvar N, Eshraghian MR, Shariatzadeh N, Kalayi A, et al. High prevalence of vitamin D deficiency in school-age children in Tehran, 2008: a red alert. Public Health Nutr. 2012;15(2):324-330.
- Çizmecioğlu FM, Etiler N, Görmüş U, Hamzaoğlu O, Hatun ŞJJocripe. Hypovitaminosis D in obese and overweight schoolchildren. J Clin Res Pediatr Endocrinol. 2008;1(2):89.
- Dong Y, Pollock N, Stallmann-Jorgensen IS, Gutin B, Lan L, Chen TC, et al. Low 25-hydroxyvitamin D levels in adolescents: race, season, adiposity, physical activity, and fitness. Research Gate. 2010;125(6): 1104-1111.
- Delvin EE, Lambert M, Levy E, O'Loughlin J, Mark S, Gray-Donald K, et al. Vitamin D status is modestly associated with glycemia and indicators of lipid metabolism in French-Canadian children and adolescents. J Nutr. 2010;140(5):987-91.
- Cockrell Skinner A, Ravanbakht SN, Skelton JA, Perrin EM, Armstrong SC. Prevalence of obesity and severe obesity in US children, 1999-2016. J Am Pancreas. 2018;141(3):e20173459.
- 22. Khazaei S, Mohammadian-Hafshejani A, Nooraliey P, Keshvari-Delavar M, Ghafari M, Pourmoghaddas A, et al. The prevalence of obesity among school-aged children and youth aged 6-18 years in Iran: A systematic review and meta-analysis study. ARYA Atheroscler. 2017;13(1):35-43.
- Rabbani A, Alavian SM, Motlagh ME, Ashtiani MT, Ardalan G, Salavati A, et al. Vitamin D insufficiency among children and adolescents living in Tehran, Iran. J Trop Pediatr. 2009;55(3):189-191.
- 24. Zakharova I, Klimov L, Kuryaninova V, Nikitina I, Malyavskaya S, Dolbnya S, et al. Vitamin D Insufficiency in Overweight and Obese Children and Adolescents. Front Endocrinol. 2019;10(1):103.
- Zekavat OR, Makarem AR, Shayan Z, Shojaee M, Karami MY. Obesity and overweight among primary school children in Iran. Minerva Pediatrica. 2014;66(6):579-584.
- Mohammadian S, Mortezazadeh R, Zaeri H, Vakili MA. Relationship between 25-hydroxy vitamin-D and obesity in 2-7 years old children referred to a paediatric hospital in Iran. J Clin Diagnostic Res. 2014;8(9):PC06.