Original Article

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Paediatrics Section

Relationship between 25-Hydroxy Vitamin-D and Obesity in 2-7 years old Children Referred to a Paediatric Hospital in Iran

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ABSTRACT

Background: Obesity is increasing in children and it can cause many complications in adulthood, such as Diabetes mellitus (DM) and metabolic syndrome. In observational studies, vitamin-D was one of the factors which were found to be associated with obesity.

Aims: To determine the association between body mass index (BMI) and serum level of vitamin-D in children who were outpatients at Taleghani Paediatric Hospital, Iran.

Settings and Design: This was a cross-sectional observational study done on 215 children who were 2 to 7 y old, who were referred to Taleghani Hospital in winter (1391 solar calendar) 2013.

Materials and Methods: In this cross-sectional study, anthropometric indices: weight, height and waist circumference were measured by using identical instruments. BMI was also determined as per CDC 2000 criteria. Vitamin-D levels were estimated by ELISA.

Statistical Analysis: Vitamin-D levels which were less than 20 nmol/L were considered as a deficiency, levels which were 20-30 nmol\L were considered as inadequate and those which were equal to or greater than 30 nmol\L were considered as sufficient. t-test, ANOVA and Pearson's correlation coefficient at a significant level of 0.05 were applied and data were analysed by using SPSS (version 16).

Results: One hundred and twenty five children (47.4%) were males and the rest were females. One hundred eighty four children (85.6%) had vitamin-D deficiency and only 31 had adequate levels of vitamin-D. The prevalence of obesity and overweight were 27%, but considering the vitamin-D status, it was found to be insignificant. However, there was a linear relationship between waist circumference and serum vitamin-D ($p<0.01$). The means and standard deviations of serum vitamin-D levels in girls and boys were 22.76 ±11.62 and 23.46 ± 9.30 nmol/L and this difference was not significant. Vitamin-D levels found in the three ethnic groups of Fars, Turkmen and Sistani showed significant differences ($p<0.002$).

Conclusion: There was a high prevalence of vitamin-D deficiency in 2 to 7 year olds. There was no significant relationship between BMI and vitamin-D, but it was recorded in ethnic groups, and there was a correlation between waist circumference and vitamin-D levels. More exposure to sunlight and prescription of vitamin supplements were recommended.

Keywords: BMI, Vitamin-D

INTRODUCTION

According to the World Health Organization's reports, in recent decades, obesity has become an epidemiologic problem [1,2]. Obesity is a cause of death in developed and developing countries and prevention of obesity is as good as prevention of a cause of death [1,3]. Obesity is increasing in children and obese children face many problems in adulthood, such as cardiovascular disorders, metabolic syndrome and pulmonary, musculoskeletal and mental difficulties. The role of heredity in causing obesity is only about 25-40% and environmental factors also cause obesity [1,3,4]. Urbanization, low physical activity, getting high energy and lifestyles are among environmental risk factors which have been identified [5].

In observational studies, the level of serum 25-hydroxy vitamin-D was found to be one of the factors which were associated with obesity, diabetes mellitus and metabolic syndrome. Vitamin-D deficiency commonly seen in the world and also, lack of vitamin-D has been investigated in different age groups in the Iranian population [6-11]. Cohort studies have also shown that increased body fat percentage and body mass index (BMI) were strongly and inversely associated with the levels of this vitamin, especially in Caucasians. This relationship was seen in adults and children in both sexes and different races, but it was found to be more clear and stable in children and adolescents [4].

MATERIALS AND METHODS

In this study, serum levels of vitamin-D and anthropometric indices were studied in children who were referred to Taleghani Hospital, Iran and the association between BMI and serum vitamin-D levels was studied as a predictor of obesity in children. The associations between abdominal circumference, vitamin-D levels, gender, age and different ethnic groups were also studied as investigating the lateral items in this population.

This cross-sectional study was done in winter of 2013. The cases were 2-7yrs old children who were outpatients at the hospital, who were not critically ill and had no exclusion criteria such as systemic diseases, for example, diabetes, hypothyroidism, rickets, renal disease, liver disease, characterized bone diseases like osteogenesis imperfecta, metabolic diseases, blood diseases such as thalassaemia, haemophilia or leukaemia, consumption of steroids or anticonvulsants or calcium, vitamin-D and other supplements in the past month. Since the sunlight is lower in winter its effect will be lower on serum vitamin-D levels so, this season, was selected for the study. Also, according to prescribed and recommend supplementation for under 2yrs infants and maturational changes occur in ages over 7yrs, children between 2 to 7 yrs were enrolled in this study.

Number of samples was determined using a 95% confidence level and a test power of 80%, by considering the means of vitamin-D

Serum levels of vitamin-D (nmol/L)	Frequency	percent
Less than 20	89	41.4
20-30	95	44.2
More than 30	31	14.4
Total	215	100

[Table/Fig-1]: Serum levels of vitamin-D in 2-7 years old children referred to Taleghani hospital

Ethnicity	Persian	Turkman	Cossack	Sistani	p-value
Weight(Kg)	16.85±3.66	16.30 ±4.15	15.50 ±2.12	14.68±4.43	0.002
Height(Cm)	102.63±10.19	98.70 ±12.17	97.50 ±13.43	96.64±11.62	0.074
Abdominal circumference(Cm)	52.11±5.43	50.20 ±4.11	52.00 ±5.65	49.74±5.20	0.001
Level of vitamin-D (nmol/L)	21.95±9.73	30.91 ±15.62	22.05 ±2.19	23.27±9.49	0.001
BMI (Kg/m^2)	15.93±2.24	16.59 ±2.03	16.43 ±2.28	15.56±2.98	0.001
Age (year)	4.52±1.44	4.18 ±1.65	3.70 ±1.83	4.07±1.57	NS

[Table/Fig-2]: The comparisons of average of variables (Mean±SD) in 2-7 years old children referred to Taleghani hospital base d on ethnicity

obtained in obese and normal groups. Duration of sample collection was three-months. Two hundred and fifteen children who were found to be eligible were selected. Weight, height, waist circumference and BMI of children were evaluated by using the same measuring instrument, by trained nurses.

BMI is a screening index in which weight in kilograms is divided by the square of height in metres. Charts which were based on age and sex were compared with the standard body mass index and its percentage tables. CDC has determined these standards (www.cdc.gov/growthcharts) CDC [12]. Measurement of weight was done using a half- kilogram scale, with children in minimal clothing and without shoes. Height measurement was performed without shoes, by using a non-elastic tape, with looking ahead and shoulders being in normal mode.

Abdominal circumference was measured by ruling out application of any pressure around the abdomen, from the navel, in metres, while the child was standing comfortable.

Classification of BMI: Greater than 95% -obese, between 85 <% to 95% -overweight, between 5-85%- normal, <5% -underweight. [13]. Serum samples were collected from these children. Samples were kept at -20°C in laboratory of hospital. All testing was done by ELISA in lab of Taleghani Hospital, by using the same test kit. Vitamin-D levels which were less than 20 nmol/L were considered as deficiency, concentrations of 20-30 nmol\L were classified as inadequate and concentrations equal to or greater than 30 nmol\L were considered as sufficient. Demographic variables were also recorded. Data were entered into a check list and they were analysed by using SPSS software (version 16). For data statistical analysis, ANOVA method was used to compare the mean of serum vitamin-D levels in different categories. Pearson's tests were used for pair wise comparisons and to assess the linear relationship between BMI and serum levels of vitamin-D respectively. Tests were considered to be significant at the 0.05 level.

RESULTS

Among 215 cases, 113 (52.6%) were girls and 102 (47.4%) were boys. Most of the subjects belonged to Persian ethnicity (66.5%) and those who belonged to Sistani ethnicity (23.3%) were the next majority. Vitamin-D level in the population was 23.09±10.57 nmol/L and the levels of vitamin-D serum in girls and boys were 22.76 ±11.62 and 23.46 ± 9.30 nmol/L respectively. This difference was not statistically significant. Deficiency and insufficiency of vitamin-D levels were > 85% in children who were studied and only 14.4% children had adequate vitamin-D concentrations [Table/Fig-1]. In this study, Vitamin-D levels were not found to be correlated with BMI.

Also, 27% children were included in obese and overweight groups. In most of the children, waist circumference was between 25-50 cm (27.9%) and average waist circumferences in girls and boys were 50.73±5.06 and 52.10±5.58 respectively.

Differences in age, waist circumference, vitamin-D levels and BMI in two genders were not statistically significant (p-value<0.01).

As has been shown in [Table/Fig-2], the mean vitamin-D level was significantly lower in subjects who belonged to the Persian ethnicity and in Turkmen group, it was found to be higher than was found in other groups.

DISCUSSION

The aim of the present study was to find the relationship between vitamin-D levels and body mass index in 2-7 y old children who were referred to Taleghani Hospital.

According to other studies done in Iran and a multicentre study which was done in Iran on prevalence of vitamin-D deficiency in 5 cities of Tehran, Tabriz, Bushehr, Mashhad and Shiraz, the highest and lowest vitamin-D deficiencies were found in Tehran and Bushehr respectively [14]. Perhaps, this was because of sunlight confounding effect, which was ruled out in our study. As per another study done by Tabriz Ghergherechi et al., most of the cases (76.9%) and control groups (42%) suffered from degrees of vitamin-D deficiency [15]. In our (this) study, > 85% of the children had serum vitamin-D levels of less than 30. In other studies such as those done by Ghergherechi et al in Tabriz, by Salehpour et al in Tehran and by Kardas et al., in Turkey, a significant relationship was found between active serum vitamin-D levels and obesity [15-17]. In our study, no significant relationship was found between obesity and vitamin D, but among different ethnic groups, waist circumference and vitamin-D levels showed significant differences. The mean vitamin-D levels found in Persian group were less than those found in all groups and in Turkmen group, the levels were higher than those which were found in other groups.

In comparison with other studies that were done in this regards in other countries, lower levels of vitamin-D were reported in a study which was done in Oman. In this study, certain types of women's clothings were recognized as a cause of lower levels of the vitamin-D [18]. In United Arab Emirates, 45.4% children were found to have vitamin-D inadequacy and 19.7% had vitamin-D deficiency [12]. In the United States, 40% were found to have vitamin-D inadequacy and 12.1% had deficiency [19]. In China, 27.4% had vitamin-D inadequacy and 21.6% had deficiency [20]. Lack of vitamin-D was more evident in this study. In a study which compared the vitamin-D levels found in Europeans and south Asian residents, the latter were found to have lower levels of vitamin-D [21]. In this study, the differences between vitamin-D levels found in various ethnic groups were not clear. Study, a significant inverse association was found between vitamin-D level and the prevalences of diabetes and metabolic syndrome. Abdominal obesity was associated with low levels of vitamin-D [21,22]. Obese patients who showed a significant linear relationship between waist circumference and serum levels of vitamin-D developed metabolic syndrome and the levels of vitamin-D were lower than obese patients who didn't have this syndrome [21].

In our study, 27% of patients were obese and overweight and this was compatible with statistical information provided by Ministry of Health, which had stated that a third of Iranian children are overweight and obese.

No significant differences were found between BMI and vitamin-D levels in the statistical analysis, which could be due to the prevalence's of vitamin-D deficiency and inadequacy found in the studied population. These were unexpectedly found to be above 85%.

LIMITATION OF OUR STUDY

1. Most of our samples were from urban population, while samples obtained from rural population were mostly sent for referral and were ill and had exit criteria.
2. We did not consider some extra factors such as life style and history of use/no use of supplements in infancy.

FINALLY WE RECOMMEND

1. Screening or preventive measures like prescription of vitamin-D supplements in age group of 2 to 7 y due to the high prevalence of vitamin-D deficiency in this age group.
2. Assessing vitamin-D levels along with BMI in the community, in order to prevent obesity and its complications.
3. Due to existence of a linear relationship between waist circumference and serum levels of vitamin-D, further studies on obesity are essential.
4. Use of fortified milk or foods which contain vitamin-D.

CONCLUSION

We found a high prevalence of vitamin-D deficiency in the form of a serum 25 OHD level which was below 30nm/ml, in a sample of children who were out patients who had come for primary care to an urban referral hospital. In this study, no correlation was found between BMI and vitamin-D deficiency. Also, no significant difference was found between genders. In this population, 22.8% children were in over weight and obese groups. This number was nearly same as that which WHO had estimated for communities. The linear relationship found between waist circumference and serum vitamin-D was significant ($p<0.01$). The mean and standard detected prevalence's of hypovitaminosis found in this study were not associated with gender and BMI, but there was a significant association among different ethnic groups and waist circumference.

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