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RESEARCH ARTICLE/ARAŞTIRMA

Vitamin D Levels of Asthmatic Children with and Without Obesity

Obezitesi Olan ve Olmayan Astımlı Çocuklarda Vitamin D Düzeyleri

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ABSTRACT

Objective: Asthma and obesity are important public health problems that affect millions of people in the world. Recently it has been shown that vitamin D may affect the prevalence of allergic disease and obesity. In this study, we evaluated the correlations between vitamin D, asthma, obesity and severity of asthma.

Materials and Methods: One hundred and nineteen subjects were included in the study. The study population consisted of four age- and sex-matched groups: Obese asthmatic children as group 1 (n:34), non-obese asthmatic children as group 2 (n:28), obese non-asthmatic children as group 3 (n:30) and non-obese non-asthmatic children as group 4 (n:27).

Results: There was no significant difference in serum vitamin D levels between groups. Also there was no difference between groups when we compared the serum vitamin D levels according to the severity of asthma.

Conclusion: There was no correlation between levels of serum vitamin D and presence of asthma and obesity.

Key words: Asthma, children, obesity, severity of asthma, vitamin D

ÖZ

Giriş: Astım ve obesite dünya genelinde milyonlarca insanı etkileyen önemli toplumsal sağlık sorunlarındandır. Son yıllarda vitamin D'nin allerjik hastalıkların ve obezitenin prevelansında etkisi olabileceği ileri sürülmüştür. Bu çalışmada vitamin D düzeyleri ile astım, obezite varlığı ve astım şiddeti arasındaki ilişki araştırılmıştır.

Gereç ve Yöntem: Çalışmaya 119 olgu dahil edildi. Yaş ve cinsiyete göre eşleştirilmiş dört çalışma grubu oluşturuldu: Obezite ve astımı olanlar Grup I (n:34), normal kilolu astımlılar Grup II (n:28), astımı olmayan obez hastalar Grup III (n:30), normal kilolu ve astımı olmayan kontrol grubu Grup IV (n:27) olarak kabul edildi.

Bulgular: Serum 25 hidroksi vitamin D düzeyleri açısından dört grup karşılaştırıldığında aralarında fark saptanmadı. Hastalar astım şiddetlerine göre serum vitamin D düzeyleri açısından karşılaştırıldığında gruplar arasında fark saptanmadı.

Sonuç: Sonuç olarak, çalışmamızda serum 25 hidroksi vitamin D düzeyleri ile astım, obezite ve atopi varlığı arasında ilişki saptanmamıştır.

Anahtar kelimeler: Astım, astım ciddiyeti, çocuk, obezite, vitamin D

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INTRODUCTION

Asthma and obesity are two major health problems that affect millions of people worldwide and prevalence of both conditions are increasing. These two health problems are frequently seen together. The main mechanism of the relationship between asthma and obesity has not been determined. Obesity is thought to effect asthma phenotype via changing breathing pattern, increasing inflammatory response, genetic mechanisms and hormonal changes (1-5).

Studies about association of vitamin D concentrations with asthma and obesity have suggested a possible relationship. The effect of vitamin D on the development of asthma, asthma severity, lung function, total Ig E and eosinophil count was investigated (6-8). Vitamin D is considered to improve immune function, to have anti-inflammatory effects, to reduce steroid resistance, to strengthen steroid effects and to reduce remodeling (9-11). Therefore, it has been suggested that vitamin D deficiency may have an effect on the rise in prevalence of allergic diseases. In birth cohorts, maternal vitamin D and cord blood level of vitamin D are reported to be inversely associated with asthma (12,13). However, in some studies evaluating adolescent patients, serum vitamin D levels were not found to be different between subjects with or without asthma (14,15).

Low Vitamin D levels have been shown to be associated with a high body mass index (BMI) in some studies (16-18) although there are reports that did not reveal a relationship (19). Vitamin D is thought to affect BMI by stimulation of lipogenesis and suppression of lipolysis (20).

As there are conflicting results on the subject, we aimed to study the relation between vitamin D levels, obesity and asthma. In this study, levels of vitamin D among obese children with asthma, non-obese children with asthma and a non-asthmatic non-obese control group were investigated.

MATERIALS and METHODS

This study was conducted in the allergy clinic of our hospital between November 2010 and March 2011. Sixty-two subjects with a diagnosis of asthma were accepted for the study. They were followed for at least one year in our clinic and were under control according to GINA criteria (21). Fifty-seven healthy sex- and age-matched subjects who did not have any chronic and/or allergic disease were included as the control group.

The height and weight of all patients enrolled in the study were measured. Body mass index (BMI)>95th percentile according to gender and age was considered obese (22). Patients in both the control and study groups were divided according to their BMI as "obese" and "normal weight". Patients were assigned to four groups: Group 1- patients with asthma and obesity, Group 2- non-obese asthmatic patients, Group 3- obese patients without asthma, Group 4-normal weight patients without asthma.

Serum vitamin D levels, eosinophil count and total Ig E levels were evaluated in all groups. Skin prick tests and pulmonary function tests were performed. Serum vitamin D levels were compared between groups and in patients with asthma, the relationship between serum vitamin D levels and asthma severity, FEV 1 levels, total Ig E levels, eosinophil counts and presence of atopy were evaluated.

A normal level of vitamin D is defined if the 25 OHD level is greater than 30 ng/mL (75 nmol/L). Vitamin D insufficiency is defined if the level is from 20 to 30 ng/mL (50 to 75 nmol/L). Vitamin D deficiency is defined if 25 OHD level is less than 20 ng/mL (50 nmol/L) (11).

Patients were excluded if they had a diagnosis of any chronic lung disease or were not considered as controlled during the study.

Laboratory Investigations

Spirometry: Lung function was measured with spirometry (Spirolab II, Rome, Italy) according to American Thoracic Society Standards (23). Patients performed at least three acceptable maneuvers and the best FEV1 measurements were used. Testing equipment was calibrated daily to ensure the accuracy and precision of the test equipment.

Skin Prick Test: Epidermal prick tests were performed on all patients with common airborne allergens including house dust mites (D. pteronyssinus, D. farinea), cat and dog danders, cockroach, mold (Alternaria alternate, Aspergillus fumigatus, Cladosporium), mixed tree (Maple, Horse chestnut, Plane, Force acacia, Lime), betulaceae, oleaceae, saliceae, mixed grasses (Bent grass, Yorkshire fog, Bermuda grass, Bromus, Barley, Maize, Oat, Wheat), Compositeae and Parietaria officinalis pollens (Stallergenes, SA Antony, France) together with a

positive (histamine 10%) and a negative control. The test was considered positive if the mean diameter of the wheal was at least 3 mm greater than the negative control test after 15-20 minutes. Atopy was defined as the presence of at least one positive skin test response.

Serum total Ig E levels were measured by nephelometry (Beckman Coulter Immage 800) and 25 OH vitamin D (ng/dl) levels by chemiluminescence (Abbott Architect I2000) in all patients.

The study was approved by the local ethics committee and written consent was obtained from all children and their parents.

Statistical Analysis

The data was analyzed using the SPSS-18 statistical software package for Windows (SPSS, Inc., Chicago, IL). For descriptive statistics, the numerical data were expressed as mean ± standard deviation and median (minimum-maximum) and the categorical data as frequencies and percentages. Categorical variables were compared with the Chi-square test. Numerical variables were analyzed with the one-way Anova test across all four groups and post-hoc analysis was performed between two groups. Correlations were analyzed using Spearman's rank correlation. $P<0.05$ was considered significant.

RESULTS

The study involved 119 patients (59 males and 60 females). The mean age of patients was 11.8±2.7 (min: 4.5, max: 17.6) years. Patients were grouped as follows: 34 asthmatic obese, 28 non-obese asthma, 30 obese without asthma and 27 non-obese control group. Vitamin D deficiency was present in 97.5% and insufficiency was present in 2.5% of our study group (24). There was no difference in age, gender, and family history of allergic disease between groups. Vitamin D levels did not differ between these groups ($p>0.05$) (Table I). The presence of atopy, FEV1 levels, total eosinophil count and percentage of eosinophils were not different between obese and non-obese asthmatic patients ($p>0.05$).

Asthma severity was defined as mild persistent in 53 patients and moderate to severe persistent asthma in 9 patients. There was no difference in age, gender, family history of allergic disease, or FEV1 levels between the groups according to the severity of asthma ($p>0.05$). Serum vitamin D levels were not different between the severity groups (mild intermittent: 10.9±4.26, mild persistent: 10.35±3.58, moderate – severe: 10.54±3.11, $p=0.957$).

Serum vitamin D levels were not different (mean 10.2±4.01 and 11.05±3.91, respectively, $p=0.33$) between patients with and without atopy.

Among patients with asthma, there was no significant correlation between vitamin D levels and total Ig E, eosinophil count, FEV1 levels (p values 0.36, 0.58, 0.36; r values 0.188, 0.132, 0.199 respectively). Also, there was no significant correlation between vitamin D levels and total Ig E, eosinophil count, FEV1 levels, fasting blood sugar, insulin resistance among patients with obesity (p values 0.280, 0.710, 0.213, 0.415, 0.243; r values -0.207, -0.080, 0.243, -0.160, -0.228 respectively). In addition, there was no significant correlation between vitamin D levels in obese asthmatic patients and total Ig E, eosinophil counts, FEV1 levels (p values 0.149, 0.691, 0.688; r values 0.275, 0.084, 0.740 respectively).

DISCUSSION

There is a parallel increase in the prevalence of obesity and asthma. Recently, it has been suggested that vitamin D may have an impact on the development of obesity and allergic diseases (1,2). The interaction between asthma, obesity, and vitamin D levels is complex. In our study, serum vitamin D levels of patients were not different statistically when compared between groups according to the presence of asthma and/or obesity. Vitamin D levels were also not different between groups according to asthma severity. A remarkable finding of the study was the very high frequency of vitamin D deficiency.

The effect of vitamin D on the development and severity of asthma has been evaluated in some studies. In a study, the frequency of vitamin D deficiency (54%) or insufficiency (86%) in 92 African-American asthmatic children aged 6-20 years was found to be higher than in healthy controls (18). However, there are other studies that did not find a difference in Vitamin D levels between patients with and without asthma (8,13-15). In accordance with these reports, serum vitamin D levels were similar in patients with and without asthma in our study. One of the reasons for discordance between the results may be differences in the climate of countries where the studies were conducted (8,25). However it is also of concern that levels of Vitamin D were low and deficiency was frequent in both the control and patient groups in some studies that

Table I. The characteristics of the study groups

	Presence of asthma		Lack of asthma		P*
Variables	**Normal weight (n:28)**	**Obesity (n:34)**	**Normal weight (n:27)**	**Obesity (n:30)**	
Gender, female, n (%)	15 (53.5)	14 (41.1)	17 (62.9)	14 (46.6)	0.336
Age (years) (mean±SD)	11.8±2.6	12.0±2.4	12.1±3.2	11.5±2.7	0.81
BMI (kg/m²) (mean±SD)	18.45±2.82	27.30±3.13	19.30±2.59	30.30±4.86	0.001
Asthma duration (months) (mean±SD)	44.50±31.92	31.50±25.32	-	-	0.104
Severity of asthma, n (%)					
Mild intermittent	10 (35.7)	12 (35.3)	-	-	
Mild persistent	15 (53.6)	16 (47.1)	-	-	0.722
Moderate–severe	3 (10.7)	6 (17.6)	-	-	
Allergic rhinitis, n (%)	16 (13.4)	16 (13.4)	0	0	0.001
Eczema, n (%)	2 (7.1)	2 (7.1)	0	0	0.168
Familial allergic diseases, n (%)	13 (46.4)	11 (32.3)	9 (33.3)	7 (23.3)	0.347
25 OH-Vitamin D (mean±SD) (min-max)	10.9±3.6 (4.2-18.4)	10.1±3.8 (5.3-23.2)	10.7±5.1 (4.0-23.0)	10.3±3.4 (4.1-17.3)	0.74
FEV-1 (%), Mean±SD	95.7±14.3	102.1±12.9	96.1±18.9	98.6±11.5	0.347
Atopy, n (%)	17 (60.7)	16 (45.7)	1 (3.7)	2 (6.8)	<0.001
Total IgE (mg/dl)	79.0±276	117±166	16.9±52.5	44.0±345	0.005
Eosinophils % (IQR)	2.9 (5.3)	2.7 (3.6)	0.9 (3.9)	1.9 (1.8)	<0.001

Familial allergic diseases: The presence of diagnosed asthma/allergic rhinitis in father/mother by a doctor
*: p value between four groups

claimed no relationship between asthma and vitamin D levels (8,14,15,18). As a matter of fact this was the case in our study as vitamin D deficiency was present in 97.5% and insufficiency was present in 2.5% of our study group and Vitamin D levels did not differ between patients with and without asthma.

It is suggested that Vitamin D deficiency increases the severity of asthma (8) but there are also studies stating the opposite. Gergen et al reported the absence of a relationship between vitamin D levels and severity of asthma among adolescents (14). Serum vitamin D levels of the patients and control group in that report was under 20 ng/ml, as was the case in our study. The generally low levels may have prevented appropriate statistical analysis. Menon et al also did not find a relation between vitamin D levels and asthma severity but 75.7% of patients had mild asthma (15). Similar to that study, nearly 89% had mild asthma in our study and this may have affected the results. Although this is a limitation of the study, it must be kept in mind that most asthmatic children have mild asthma.

In some studies, it has been shown that serum vitamin D level affects lung function (6,9). A positive correlation between vitamin D levels and FEV1 was shown in studies conducted in both adults and children with asthma (6,26). In our study, we did not find any correlation between vitamin D levels and FEV1.

In some studies, no relationship was observed between obesity and asthma, asthma severity and FEV1 (27-30). Two studies by National Health and Nutrition Examination Survey (NHANES III) and the European Community Respiratory Health Survey (ECRHS) found no relationship between obesity and frequency of atopy among children (31). Similarly in our study, the presence of obesity did not affect frequency of atopy and the level of FEV1(32).

There are differing results in the literature about the relationship between vitamin D levels and the development of obesity. Two studies conducted among 2162 and 302 adult patients have reported a negative relationship

between obesity and vitamin D level (16,17). However, in accordance with our results, a study that evaluated 259 patients aged 20-64 years by Baradaran et al. did not find a significant relationship between body mass index and vitamin D level (19). Also a report from our country by Aypak et al. (33) did not find a relationship between obesity and vitamin D levels.

One of the limitations of our study is the generally low level of serum vitamin D both in patient and control groups and this may have affected the statistical analysis. Vitamin D deficiency is based on inadequate sunlight exposure and inadequate intake. Although it is one of the Mediterranean countries, it is reported that vitamin D deficiency is quite common in Turkey (40-74.9%) (34,35). This is unexpected because vitamin D supplements are administered to all children after birth and to mothers during the pregnancy and lactation periods in Turkey. Another limitation of our study is the low numbers of patients for each group who were included in the study.

According to our results, serum vitamin D levels in children with asthma do not affect asthma severity or presence of obesity. However, the low levels of vitamin D in the study groups may have affected the results.

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