ORIGINAL ARTICLE

ANALYSIS OF ALLERGIC DISEASES IN OBESE CHILDREN

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Abstract

Introduction: Recent studies have indicated that there might be a link between asthma and obesity in both children and adults. The aim of this study is to evaluate the prevelance of allergic symptoms, lung function tests and atopic sensitization in obese children.

Methods: Fifty children, who had body mass index (BMI) above 95% and admitted to hospital because of obesity between October 2010 and April 2011, were included to the study. ISAAC (International Study of Asthma and Allergies in Childhood) questionnaire, skin prick tests and pulmonary function tests were performed in all participants.

Results: Six (12%)patients, showed a positive reaction to mites, grass pollens and molds in skin prick tests. In evaluation of ISAAC questionnaire, symptoms relating to asthma in 15 (30%) patients, allergic rhinitis in 31(62%) patients and atopic dermatitis in 6 (12%) patients were defined. Three (6%) patients were diagnosed as allergic asthma and allergic rhinitis confirmed by positive skin tests. The pulmonary function tests of patients with asthma related symptoms were not found to be significantly low in more obese patients.

Conclusion: Asthma related symptoms like exercise intolerance, night cough and wheezing history were found to be related to allergic diseases in only few patients. So, it may be considered that these symptoms may be related to obesity and low exercise capacity rather than allergic asthma.

Key Words: Obesity, asthma, allergic disease.

Introduction

An increase in the prevelance of obesity has been reported worldwide as well as simultaneous rise in the prevelance of asthma and atopy over recent decades. The investigators speculated that obesity might be a causal factor of atopic diseases. (1) It was suggested that proinflammatory cytokines released from adipocytes induce to Th2 type inflammatory response. (2)

Influence of body mass index (BMI) on the allergic disease is contradictory in the literature. Xu et al (3) and Hancox et al (2) did find an association of high BMI with atopy. Association of BMI with respiratory symptoms and lung functions have been more pronounced in girls additionally. (2,4,5) The association seems to be complex resulted from interactions between genetic and enviromental influences. (6)

The objective of this study is to evaluate prevelance of allergic disease in obese children, using ISAAC (International Study of Asthma and Allergies in Childhood) questionnaire (7), skin prick tests and pulmonary function tests.

Materials and Methods

Fifty obese patients, between 6-18 years of age, admitted between October 2010 and April 2011 for obesity to Ankara University, Department of Pediatric Endocrinology were included to the study. The study was performed in Department of Pediatric Immunology-Allergy after approval from the ethical committe. Informed consent form was signed by parents of all patients.

BMI was calculated as weight in kilograms divided by the square of the height in meters. Gender spesific BMI reference values for Turkish children (8) were used to identify increased BMI. The patients who had BMI >95% were included to the study. Because BMI >30 defined as obesity in adults, is considered very high for children we divided the patients into 2 groups as BMI >30 and BMI <30 for comparison.

The questions addresing respiratory and allergic disorders adapted from standardized ISAAC questonnaire were distributed to the parents or the patients.

Spirometric measurements were performed with at least 3 acceptable maneuvers and the test with best FEV1 (forced expiratory volume) and FVC (forced vital capacity) were recorded. All children were asked to avoid using any of inhalers on the day of test. In the case of decrease in lung function tests, measurements were repeated 15 minutes after administration of salbutamol for observation of bronchodilatator response.

Skin prick testing with 14 the most common aeroallergens was performed. The allergen panel consisted of Dermatophagoides pteronyssinus, Dermatophagoides farinea, Alternaria, Aspergillus fumigatus, cat fur, dog hair, mixed grass pollens, mixed tree pollens, mixed weed pollens and cockroach (Stargoallergens, NY, USA). Histamin was used as positive control and saline as negative control. The flare and wheal reaction on the skin was measured after 15 minutes following inoculation of each allergen exract. The largest wheal diameter was compared with positive and negative control. A positive test was defined as at least 3 mm diameter of wheal, after substraction of negative control. Antihistamines was suspended 3-10 days before skin prick tests. Children with a positive reaction to any of the 14 allergens were considered as atopic.

Statistical Methods

All analysis was performed by SPSS 15.0 programme. Data were analysed by Chi-square or Fischer's exact test to study differences in gender and BMI groups. To compare the results of lung function tests, T-test was performed. P value <0.05 was considered statistically significant.

Results

Male: female ratio was 1.27. Mean age of girls was 11.5 $\pm$ 2.3 years (range:6.5-16 years), while it was 11.6 $\pm$ 2.7 years (range:6-15.6 years) in boys (p=0.953). BMI ranged between 20.5-36.2 kg/sqm (Mean 27.5 $\pm$ 3.6 kg/sqm). BMI averages were not high in girls (27.1$\pm$ 3.4) than boys (28.1$\pm$ 3.9) (p= 0.294).

Table I. The comparison of lung function tests according to BMI groups and atopic status

	BMI			Atopic Status		
% of predicted values for child	BMI ≥30 (n=13)	BMI <30 (n=37)	P value	Atopic children (n=6)	Non-atopic children (n=44)	P value
FEV1 (L)	94.3±8	91.3±13	0.455	99.5±11.9	91.1±11.7	0.110
FVC (L)	93.8±12	88.7±14	0.271	99.3±15.0	88.8±13.7	0.088
FEV1/FVC (%)	100.7±9	101.8±11	0.753	101.8±14.8	101.5±10.1	0.951
PEF (L/s)	76±13	76.7±18	0.891	80.6±16.4	76.0±16.9	0.529
MEF25 (L/s)	80±20	77.4±22	0.717	79.1±15.2	77.9±22.7	0.898
MEF50 (L/s)	93.6±20	86.5±21.6	0.310	87.5±14.9	88.5±12.2	0.916
MEF 75 (L/s)	95.1±20	89.3±27	0.376	88.8±16.5	91.8±27.0	0.803
MEF25-75 (L/s)	100±18	92.2±23	0.290	92.5±13.5	94.5±23.4	0.838

FEV1 = Forced expiration volume after one second, FVC= Forced vital capacity, FEV1/FVC= PErcentage of FEV1 against FVC, PEF= Peak expiratory flow, MEF25= The maximum flow acheivable when 75% of the FVC has been expired, MEF50= The maximum flow acheivable when the lungs are half-empty, MEF25-75= Forced mid-expiratory flow, MEF75= The maximum flow acheivable when 25% of the FVC has been expired

14 girls (50%) and 10 (35%) boys were above 12 years of age. Average BMI in the children above 12 years was significantly higher in boys (30.0 ± 3.3 kg/sqm)than girls (25.2 ± 2.8 kg/sqm). (p=0.001). There were no difference in lung function volumes between these two BMI groups (BMI>30 and those below 30) (Table 1). In girls, mean of peak expiratory flows (PEF) and mean expiratory flow (MEF25) were found to be 71.9 L/s ± 15.4 and 71.6L/s ± 20.3, respectively. These values were significantly lower than boys which were 82.4± 16.9 for PEF and 86.2 ± 21.5 for MEF25 (p=0.026, p=0.018 respectively). Forty four (88%) patients had negative skin prick tests and 6 (12%) had at least one positive skin reaction. Positive reactions were seen to house dust mites (in 1 patient), grass pollens (in 4 patients) and molds (in 1 patient). Pulmonary function test parameters did not differ between atopic and non-atopic patients. (Table 1)

As per ISAAC questionnaire, symptoms relating to asthma were seen in 15 patients (30%), allergic rhinitis were seen in 31 patients (62%) and atopic dermatitis were seen in 6 patients (12%). The summary of answers to core questions of ISAAC according to gender and BMI were showed in Table 2. Three of the all patients were diagnosed as allergic asthma with allergic rhinitis and confirmed with positive skin tests. Two patients were atopic in the BMI >30 grup, while 4 patients in the BMI <30. There was no statistically significant difference between these groups (p=0.568).

According to ISAAC questionnaire asthma related symptoms such as exercise intolerance were seen in 5 (10%), night cough in 20 (40%) and wheezing history in 15 (30%) patients. Five of 8 patients having forced expiratory volume (FEV1) below 80% described asthma related symptoms and 2 of these 5 patients showed positive skin prick test reaction. The others were considered as nonatopic asthma and asthma medication was started to all 5 patients. Patients with asthma related symptoms did not show significant difference in FEV1 values (Table 3). Only 4 of 31(13%) patients describing allergic rhinitis symptoms in ISAAC questionnaire had positive skin test with grass pollens. None of the patients with eczema found to be allergic to any inhalant allergen.

Discussion

In the literature, there are conflicting report about the influence of BMI on the allergic status. Hancox et al found that there were trends to an association between wheeze and BMI at all ages, although this was only significant from age 15. (2) On the contrary, van Gysel et al showed that the prevalence of sensitization was higher in underweight girls. (1) Association between BMI and respiratory symptoms or lung functions have been more stronger in girls and women than in boys and men. (2,4,5) Why the association between BMI and asthma is more often observed in girls is unknown. But it may be partially explained that girls have a greater percentage of body fat than boys. (9) It was reported that a higher BMI was associated with a lower FEV1/FVC ratio, indicating that overweight was associated with airflow obstruction and respiratory symptoms.

Table 2: The answers to core questions of ISAAC according to gender and BMI

ISAAC Core Question	Girls (n=28)		Boys (n=22)			BMI <30 (n=37)		BMI ≥30 (n=13)		
	Yes	No	Yes	No	p	Yes	No	Yes	No	P value
Have you ever wheezing or whistling at the chest at any time in the past?	7	21	8	14	0.384	12	25	3	10	0.527
Have you ever had asthma?	2	26	1	21	0.701	3	34	0	13	0.290
In the past 12 months, has your chest sounded wheezy during or after exercise?	3	25	2	20	0.849	5	32	0	13	0.162
In the past 12 months, have you had a dry cough at night, apart from a cough associated with a cold or chest infection?	11	17	9	13	0.907	16	21	4	9	0.430
Have you ever had hay fever?	9	19	2	20	0.051	8	29	3	10	0.962
Have you ever had hay eczema?	3	25	1	21	0.447	4	33	0	13	0.216

Table 3. Comparison of FEV1 according to ISAAC answers

ISAAC Core Question		FEV1		
		<80%	>80%	P value
Have you ever wheezing or whistling at the chest at any time in the past?	Yes No	4 4	11 31	0.178
Have you ever had asthma?	Yes No	8 8	3 39	0.439
In the past 12 months, has your chest sounded wheezy during or after exercise?	Yes No	1 7	4 38	0.797
In the past 12 months, have you had a dry cough at night, apart from a cough associated with a cold or chest infection?	Yes No	3 5	17 25	0.875
Have you ever had hay fever?	Yes No	0 11	8 31	0.101
Have you ever had hay eczema?	Yes No	1 3	7 39	0.609

This inverse association was independent of asthma diagnosis. (2,10) It is possible that asthma related symptoms could be the results of the increased work of breathing associated with obesity rather than airway inflammation. Our data showed an association between obesity and asthma related respiratory symptoms. This effect is unlikely to be related to atopy. Mechanical properties of the respiratory system (11) and an increased occurence of gastroesophageal reflux (12) may be associated with symptoms mimicking asthma in obese patients.

Obesity also has been shown to be related to pulmonary dysfunction such as diminished tidal lung expansion. (13,14) The major respiratory complications of obesity include a increase in demand for ventilation, elevated work of breathing, respiratory muscle insufficiency and diminished respiratory complication. (15) Asthmatic symptoms were described due to deposition of adipose tissue in the chest wall and the airways leading to narrow airways in one study. (16)

We found the rate of atopic sensitization in our obese children group as 12%. Although this rate was lower than a larger series in the literature in which atopy was found to be about 60% of obese children, the rate was found higher than normal population. (17) Von Mutius et al reported that the prevalence of asthma, hay fever rose significantly with increase in BMI in 7505 children aged between 4-17 years, but no interaction between atopy and BMI was found. (6) Thus the relation between BMI and asthma may reflect the predisposition of an asthmatic child to gain weight because of reduced exercise tolerance rather than a causal association between a high BMI and the inception of asthma. Likely, Rasmussen et al demonstrated that low physical activity in childhood was associated with the development of asthma in young adulthood. (18)

ISAAC questionnaire has been proved to be valid to identify the risk factors for allergy. (19,20) Nevertheless, limitations were observed not certainty in early life history of the child and some misunderstanding in questions especially in rhinitis section. We observed

that some of the patients answered as 'yes' to the question of 'did you have rhinitis symptom without upper airway infection?'. But these patients did not describe any seasonal or allergic feature in the next questions.

In present study, we saw that obese children can manifest upper and lower respiratory system symptoms regarding allergic sensitization or not. The limitation of this study is not using healthy control group.

In conclusion, allergic sensitization was shown in 12% of our obese patients. Allergic diseases should be kept in mind in obese patients and should be asked for allergic symptoms. In addition, exercise intolerance, night cough and wheezing history were found to be related to allergic diseases in only a few patients. So, it may be considered that these symptoms may be related to obesity and low exercise capacity rather than allergic asthma. Appropriate strategies for the reduction of body weight may contribute to reduced incidence of asthma in childhood.

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