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Effect of Inhaled Corticosteroid Treatment on Body Composition Parameters in Children with Asthma

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ABSTRACT

Objective: Prolonged treatment with low doses of inhaled corticosteroids may affect the growth rate; however, limited data are currently available for body composition parameters in children with asthma. We examined whether treatment with inhaled corticosteroids has an effect on body mass index, basal metabolic rate, percentage body fat, obesity degree, fat mass, and muscle mass in children with mild asthma.

Materials and Methods: The study was performed in 45 children with mild persistent asthma being treated with inhaled corticosteroids and 45 healthy controls. Body composition parameters; body mass index, percentage body fat, obesity degree, basal metabolic rate, body fat mass, muscle mass, and waist-hip circumferences were measured. Written questionnaires including duration of television/computer viewing, frequency of fast food consumption, and weekly physical activity were completed.

Results: There was no difference in body composition parameters and waist-hip circumference measurements between the groups. A positive correlation was demonstrated between the duration of inhaled corticosteroid treatment and the percentage of body fat, muscle mass, fat mass, and hip circumference. When compared with healthy controls, a significant increase in the duration of television/computer viewing and frequency of fast food consumption and a significant decrease in weekly physical activity were observed in children with asthma.

Conclusion: Body composition parameters seem not to be affected in the inhaled steroid-using children with asthma. However, as the duration of inhaled corticosteroid treatment increased, the percentage of body fat, body fat mass, and hip circumference also increased. Children with asthma should be encouraged to increase physical activity and be recommended to decrease the duration of television/computer viewing.

Keywords: Inhaled corticosteroids, body composition, children, asthma

INTRODUCTION

The objective of asthma treatment is to control asthma symptoms, maintenance of well-being, and improve impaired quality of life. Preventive anti-inflammatory effects of therapy help to control the clinical symptoms if used long-term and regularly. The most effective drugs are inhaled corticosteroids (ICS) which control asthma symptoms, reduce the number and severity of asthma exacerbations, decrease emergency department visits, enhance the quality of life, and improve respiratory function test results and bronchial hyperresponsiveness. Prolonged treatment with ICS in children may affect the growth rate; however, limited data are currently available for the body composition parameters.

Bioelectrical Impedance Analysis evaluates the body composition by measuring the fat mass, body fat mass (%), total body water, basal metabolic rate, body mass index, and the total body resistance to electrical current. Most of the studies that evaluate the side effects of ICS are about children aged over 5 years (1-3). While prolonged treatment with low dose ICS may affect the growth rates of children, studies about the effect of treatment with

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fluticasone propionate or beclomethasone for more than one year on the body parameters including the percentage of body fat (PBF) and muscle mass are limited (4).

In our study, we aimed to examine the effect of ICS treatment on body mass index, PBF, obesity degree, basal metabolic rate, body fat mass, and muscle mass and to determine the frequency of fast food consumption, duration of television/computer viewing, and weekly physical activity in children with asthma.

MATERIALS and METHODS

Patient and Study Design

The study was performed at the Baskent University Ankara Hospital during the period of February 2014-May 2015. Forty-five patients with mild persistent asthma and forty-five healthy children aged 4 to 9 years and who presented to the pediatric allergy and pediatrics outpatient clinics were included in the study. The patients had used 200 mcg fluticasone propionate per day for at least 6 months, had not experienced asthma exacerbation during the last 3 months, and had not received systemic corticosteroid treatment for more than ten days during the last year. According to the severity of asthma exacerbations, the patients were divided into two groups as mild and moderate. The patients who were included in the study were evaluated according to GINA criteria (5). We evaluated the patients for age, sex, body weight, height, presence of atopy, duration of treatment, the severity of asthma exacerbation, and the number of exacerbations in the last year. All patients had prick tests prior to the study and results were obtained from the medical records. In order to avoid confounding effects, patients who had taken oral steroid therapy for more than ten days before admission, patients with flare-ups during the last 3 months, and patients with chronic diseases were excluded from the study.

Asthma was diagnosed according to the Global Strategy for Asthma Management and Prevention Classification based on a history of intermittent wheezing and demonstration of reversible airway obstruction as defined by at least a 12% improvement in forced expiratory volume in 1 s (FEV1) following bronchodilator administration.

Pulmonary function tests were performed with spirometry (Flowhandy Spirometer ZAN 100, ZAN Messgeräte GmbH, Germany). Forced expiratory volume in one second, forced vital capacity (FVC), FEV1/FVC, and forced expiratory flow (FEF25-75) were measured. An adequate test required a minimum of three acceptable FVC maneuvers. While performing spirometry, a minimum of three flow-volume loop results were obtained. Acceptable repeatability is achieved when the difference between the largest and the next largest FVC is ≤0.150 L and the difference between the largest and next largest FEV1 is ≤0.150 L.

Body composition parameters; body mass index (BMI), percentage body fat (PBF), obesity degree (OD), basal metabolic rate (BMR), body fat mass (FM), and muscle mass (M) were measured with the InBody 230-MW-160 (Biospace, Korea) and waist-hip circumferences were measured in both children with asthma and healthy controls. Written questionnaires about the duration of television/computer viewing, frequency of fast food consumption, and weekly physical activity were completed by the parents/guardians of all children.

Body composition parameters, waist, and hip circumferences, duration of television/computer viewing, frequency of fast food consumption, and weekly physical activity were evaluated and compared between groups.

The correlation between pulmonary function tests and body composition parameters, waist and hip circumferences, duration of inhaled fluticasone propionate treatment, the severity of asthma exacerbation, number of exacerbations in last year, and the presence of atopy were evaluated in children with asthma.

This study was supported by the Baskent University Research Fund (KA14/170). The study was approved by the Baskent University Ethics Committee and written informed consent was obtained from all subjects and their families prior to the study.

Statistical Analysis

Data are presented as the number of observations (n), mean ± standard deviation, median, or min-max values. The results of homogeneity (Levene's test) and normality (Shapiro-Wilk test) were used to decide the statistical methods for comparing the study groups. Among normally distributed groups with homogeneous variances, dependent groups were compared using Student's t-test, and independent groups (three or more) were compared using analysis of variance. According to the test results, parametric test assumptions were not available for some variables; therefore, the independent groups were compared using the Kruskal-Wallis test. For multiple comparisons, the adjusted Bonferroni test was used. Categorical data were analyzed using Fischer's exact test and the chi-square test. In cases in which the expected counts for inclusion were not met in less than 20% of the cells, the "Monte Carlo Simulation Method" was used and the values were determined. Two continuous variables, the relationship between Pearson Correlation Coefficient In the case of providing the prerequisites for parametric tests were evaluated by the Spearman correlation coefficient. All statistical analyses were performed with the SPSS software (SPSS Ver. 17.0; SPSS Inc., Chicago IL, USA). A p value of < .05 was considered statistically significant.

RESULTS

Forty-five children (22 girls, 23 boys) with mild persistent asthma and forty-five healthy children (21 girls, 24 boys) as the control group were included in the study. The mean age of children was 5.9±1 years (4.5-8.5, median 6.2) and did not differ significantly between groups (Table I). BMI of children was under 25 kg/m². Twenty-six (58%) children had only one asthma exacerbation and 19 (42%) children had more than one asthma exacerbation last year. The duration of inhaled corticosteroid treatment was 8.8±3.8 months. According to the severity of asthma exacerbations, 31 children with asthma were categorized as mild and 14 were in the moderate exacerbation group (9 girls, 5 boys). Twenty-nine children (64.4%) had atopy.

Body weight, height, body composition parameters (BMI, PBF, OD, BMR, FM, and M), waist and hip circumferences did not show a statistically significant difference between the two groups. The demographic features are given in Table I.

When children with asthma and healthy children were compared, a significant increase in the frequency of fast food consumption and a significant decrease in weekly physical activity were observed in children with asthma ($p<0.01$) (Table II). When we evaluated children with asthma according to exacerbation frequency in the last year, the children with more than one exacerbation had more fat mass and higher hip circumference than children with ≤1 exacerbation ($p<0.05$) (Figure 1, 2). The children with atopy had less PBF than children with no atopy ($p<0.05$).

Table I: Characteristics of children with asthma and healthy controls.

	Asthma n=45	Control n=45	p
Gender (Female/Male)	22/23	21/24	0.8
Age (year)±SD	5.9±1	5.6±1.3	0.25
Height (cm)±SD	117.1±7.4	114.4±10.72	0.16
Weight (kg)±SD	25.8±2.6	20.7±5.5	0.17
BMI ±SD (kg/ m²)	15.5±1.4	15.60±1.7	0.73
OD ±SD (%)	99±9.5	97.5±11.2	0.44
PBF ±SD (%)	31.35±38.31	25.16±19.81	0.98
BMR±SD (kcal)	728.8±50.6	704.35±105.08	0.19
Muscle mass (kg) ±SD	9.6±12.78	7.23±2.06	0.14
Fat mass (kg) ±SD	6.3±10.4	5.4±3.8	0.26
Waist circumference (cm) ±SD	55.3±2.7	55.68±3.42	0.85
Hip circumference (cm) ±SD	57.4±2.8	57.43±3.75	0.45
FEV1 (L) ±SD	101.2±12.82		
FVC (L) ±SD	98.3±8.7		
FEV1/FVC ±SD (%)	105.2±4.98		
MEF 25-75 ±SD (%)	116.24±23.2		

BMI: Body mass index, **BMR:** Basal Metabolic Rate, **FEV1:** Forced expiratory volume in 1 second, **FVC:** Forced vital capacity, **MEF25-75:** Maximal expiratory flow, **OD:** Obesity degree, **PBF:** Percentage body fat.

Table II: Comparison of daily TV/computer viewing, weekly junky food consumption and weekly sports activity of children with asthma and healthy controls.

		Asthma n=45	Control n=45	p
Daily TV/computer viewing, n(%)	<1 hour	3 (6.7)	10 (22.2)	0.06
	1 hour	33 (73.3)	34 (75.6)	
	>1 hour	9 (20)	1 (2.2)	
Weekly junk food consumption, n (%)	none	3 (6.7)	17 (37.8)	0.01
	1x	23 (51.1)	18 (40)	
	>1x	19 (42.2)	10 (22.2)	
Weekly sport activity, n (%)	none	25 (55.6)	9 (20)	0.01
	1 hour	20 (44.4)	32 (71.1)	
	>1 hour	0 (0)	4 (8.9)	

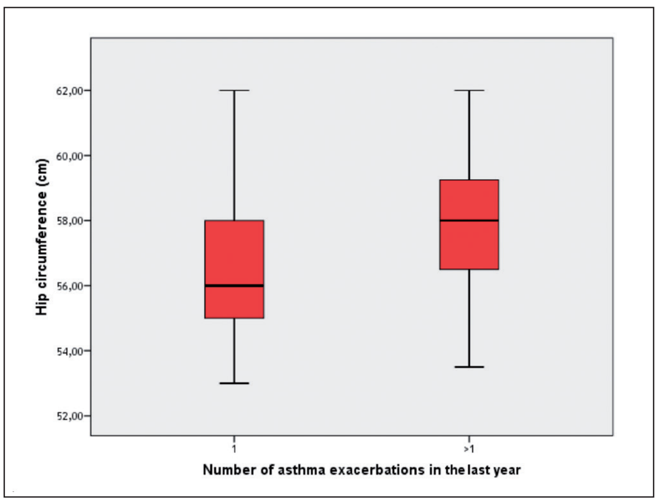

Figure 1. Comparison of hip circumference according to number of asthma exacerbations in the last year.

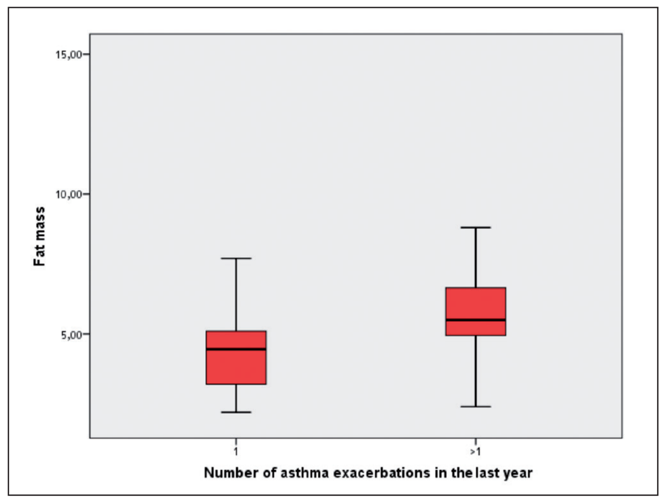

Figure 2. Comparison of fat mass according to number of asthma exacerbations in the last year.

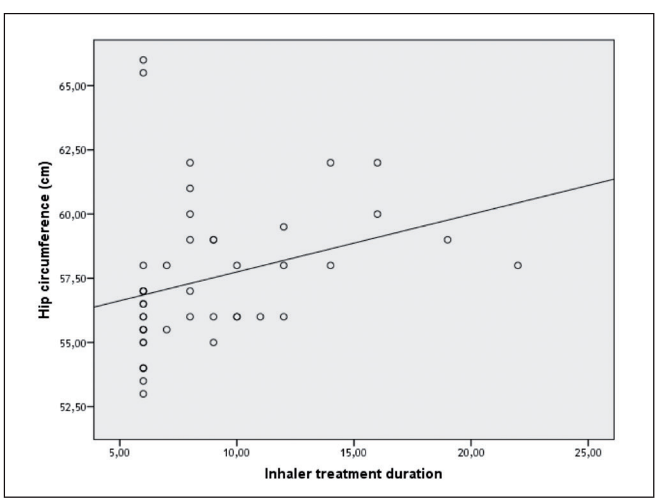

Figure 3. Correlation between duration of inhaled steroid treatment and hip circumference in children with asthma.

Body compositions, and waist and hip circumferences did not differ significantly according to asthma severity. No significant correlation was found between pulmonary function tests and body composition parameters. The duration of inhaled corticosteroid treatment was positively correlated with PBF (spearman's rho=0.316, $p<0.05$), fat mass (spearman's rho=0.435, $p<0.01$), and hip circumference (spearman's rho=0.467, $p<0.001$) (Figure 3). In the asthma group, when we categorized children according to age as 4-6 years and >6 years there was no difference in fat mass (p=0.61), PBF (p=0.44), and hip circumference (p=0.12) between the groups.

Age, frequency of junk food consumption, duration of sports activity, and TV/computer viewing did not show a statistically significant correlation with PBF, fat mass, muscle mass, and hip circumference in children with asthma.

DISCUSSION

Asthma is a common chronic disorder of the airways. Side effects of ICS depending on the type, dose, and route of administration were reported (6,7). We examined whether at least a six-month intake of inhaled steroid has an effect on body composition, basal metabolic rate, and waist and hip circumference in children with asthma.

The features that distinguish our study from other studies are that the children with asthma were young and were using low dose ICS treatment.

Bioelectrical impedance analysis is a safe, indirect, and relatively low-cost method that is used for the evaluation of body composition in recent years. In our study, we used this method to evaluate the body compositions of our patients. Although detailed studies evaluating body compositions were not observed in children with asthma, body adiposity in adults with asthma has been evaluated (8). Salvatoni et al. showed that 6-month ICS therapy has not caused increased body adiposity or decreased growth rate in children with asthma (4). Their study was performed in a relatively shorter period and offers limited data for the body composition of children with asthma using ICS therapy. However, in our study, OD, PBF, BMR, BMI, muscle mass, and fat mass were also examined and provided more data about body composition parameters.

A recent study identified that boys with high BMI have a lower FEV1/FVC ratio than children with normal BMI (9). Wang et al. found that girls with higher BMI have higher FEV1 and FVC and boys with higher PBF and fat mass have lower FEV1 and FVC (10). In our study, there was no difference in BMI values between children with asthma and healthy children. As the increase in fat mass causes a decline in lung function tests, the presence of potential mechanisms such as mechanical effects of fat mass on lung function tests and obesity-mediated increase in inflammatory markers that restrict airway can be considered. In contrast, we did not find any significant association between waist-hip circumferences, and FEV1 and FVC in our study. The absence of a waist and hip circumference difference between boys and girls may be due to the prepubertal age of our patients.

In a six-month-long study that examined the effect of ICS treatment on body adiposity, no difference was found in the fat mass before and after treatment (4). Berthon et al. have shown that there was no difference in weight and body composition parameters before and after the steroid treatment in adult asthma patients (11). Similar to other studies, our study also did not show any significant difference in weight and body composition parameters between healthy controls and children with asthma receiving inhaled fluticasone propionate treatment. Considering all of these studies, long-term use of ICS or short-term use of oral corticosteroids do not affect body composition parameters. However, in our study, a positive correlation was found between the duration of inhaled corticosteroids and body composition parameters (PBF, fat mass) and hip circumference. These relevant results support that changes in body composition parameters may be associated with an increase in cumulative ICS dosage due to prolonged treatment. We believe that there is a need for new studies including larger populations and a longer duration of ICS treatment.

Bafadhel et al. showed that there is no relationship between fat mass and lung function, airway inflammation, and exacerbation frequency (12). In our study, we found that fat mass and hip circumference had a positive association with the number of asthma exacerbations in a year. This situation may be thought of as a result of children with asthma supposing that they can not participate in physical activity or the belief of the parents that their children should not exercise and should restrict their activity in this sense. The excess number of exacerbations resulting in an increase in cumulative doses of inhaled and oral corticosteroids may cause an increase in fat mass and hip circumference in children with asthma.

A fat marker, BMI, used in many studies that investigate the relationship between obesity and asthma or atopy is not sufficient to estimate the fat distribution and body adiposity due to the inability in differentiating fat mass and muscle mass. Wang et al. have found a positive correlation between asthma and PBF and truncal fat mass when evaluating adiposity criteria such as BMI and PBF and their associations with asthma, atopy, and lung function in girls. There was no relationship between lipidosis and atopy (10). In our study, non-atopic children with asthma who had normal BMI had more fat mass and less muscle mass. More detailed studies are needed on this subject.

Vangeepuram et al. identified that children who were treated with asthma control therapy, spend more time on the computer and the TV and less time with physical activity. Many studies have highlighted the presence of low physical activity in children with asthma (13-19). A study has shown that 2.8 hours of daily activity per week is much more effective in providing asthma control than 33 minutes of moderate-intensity activity per week in ICS using children (20). Lang et al. have identified that children with asthma who restrict their physical activity were watching TV more than children who do not restrict their activity (18). In a similar manner, we found that asthmatic children had more screen time and participated in less sport than the control group. We think that children with asthma suppose they can not do physical activity due to asthma, and parents restrict their children because of the disease. Restricting physical activity and increasing the stay at home period increase the occurrence of atopy depending on house dust exposure in these children (21). An increase in activity levels of children with asthma can be achieved by informing the parents about compliance to preventive treatment and the ability of their children to participate in activities. Limiting physical activity can be prevented by informing the parents that physical activity, while asthma is under control, will not cause asthma exacerbations in children with asthma.

Ellwood et al. have shown that more than three types of fruit consumption per week may be protective on development of severe asthma symptoms and more than three junk food eating episodes per week is related to severe asthma symptoms (22). This result also suggests spending more time on the TV/computer causes more consumption of junk food in this period. In our study, junk food consumption was significantly higher than the control group. Besides the importance of junk food consumption as an increasing global public health problem, the parents must also be informed in terms of the negative impact of obesity on asthma.

Our study is the first study that examined body compositions of young children with asthma using low dose ICS. The limiting factors of our study was the low number of the patients and the cross-sectional design. Longer treatment could also have resulted in different findings. We believe that more comprehensive studies will be more descriptive in revealing the effects of corticosteroids on body compositions.

CONCLUSION

Using low dose inhaled fluticasone propionate for more than 6 months seems to have no effect on body composition parameters, and waist and hip circumference measurements in children with asthma. However, we observed that there is a positive correlation between the duration of ICS treatment and PBF, fat mass, and hip circumference. We believe that these results might be related to cumulative corticosteroid doses and exercising less. As the duration of ICS treatment increases, the body composition parameters may increase proportionally. Since the daily time spent on TV/computers and daily snack consumption is higher and weekly sports activities were lower in children with asthma, patients should be encouraged to exercise and their families should be informed about the benefits of exercising.

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