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Influence of Anthropometric Measurements in Lung Function in Patients With Asthma

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ABSTRACT

Background: Obesity is commonly regarded as a risk factor for asthma development, poor asthma control, and poor response to asthma therapy.

Methods: In a cross-sectional study, 85 asthmatics (37 male and 48 female) participated. Pulmonary function tests (PFTs) and anthropometric parameters were measured for each patient.

Results: Mean age and median duration were 43.9 ± 10.61 and 6 (3–14) years, respectively. Among anthropometric parameters, only waist-to-hip ratio (WHR) indicated significant correlation with PFTs in both sex ($P < 0.05$). There were negative associations between waist circumference, hip circumference and WHR with PFTs only in overweight and obese women ($P < 0.05$).

Conclusions: Some anthropometric parameters affected lung function, and it seems that gender differentially contributes to this effect.

Keywords: Asthma, body mass index, obesity

INTRODUCTION

The prevalence of obesity and asthma has been increasing throughout the world in recent decades.[1] Research seems to support a relationship between obesity and asthma.[2] Obesity and increasing adiposity have proven to be a risk factor for incident asthma[3] and make a unique phenotype of the disease.[4] Obese patients with asthma demonstrate different asthma phenotype compared with patients of normal weight is associated with decreased glucocorticoid responsiveness, an inability to achieve adequate asthma control, increased symptoms and exacerbations.[4,5] The aim of this study is, therefore, to evaluate the influence of anthropometric measurements on pulmonary function parameters in asthmatic patients.

METHODS

Study subjects

In this cross-sectional study, subjects were patients who refer to subspecialty clinics of Tabriz University of Medical Sciences from both sexes in June 2012. The participants were chosen via convenience sampling. Inclusion criteria were the age 18–80 years with a diagnosis of asthma at least 1-year by two pulmonologist according to the Global Strategy for Asthma.[6] Then, participants had a history of smoking or other lung disorders and respiratory tract infections, they excluded from the study. Demographic characteristics were recorded for each person via a

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questionnaire created for the study. At the first of this study, written informed consent was obtained from every participant. This project was approved by the Ethics Committee of Tabriz University of Medical Sciences.

Anthropometric measurements

During height and weight measurements patients wore light clothing and were barefoot. Body mass index (BMI) was calculated as weight in kilograms divided by the square of the height in meters and was categorized into underweight ($\leq$18.5), normal weight (18.5–24.9), overweight (25–29.9) and obesity ($\geq$30) according to the World Health Organization classification.

Measuring waist circumference (WC) (halfway between the 10th rib laterally and the most superior part of the anterior superior iliac crest) and hip circumference (HC) (largest circumference between the waist and knees) using a tape with a nearest 0.1 cm was determined by a research assistant. Waist-to-hip ratio (WHR) was then calculated.

Respiratory function tests

Pulmonary function tests (PFTs) including forced expiratory volume in 1 s (FEV_1 [%predicted: %pred]), peak expiratory flow (PEF [%pred]), forced vital capacity (FVC [%pred]) and FEV_1/FVC% were measured by two trained nurses using spirometer (Spiroanalyzer ST-300; Fukuda Sangyo, Tokyo, Japan) in the morning.

Statistical analysis

Data were analyzed using the SPSS software version 16.0 (SPSS Inc., Chicago, IL, USA). The results were expressed as mean (standard deviation). Comparison of variables between BMI groups was made using one-way ANOVA and Kruskal–Wallis test for normal and nonnormally distributed data, respectively. Correlation between anthropometric measurements and PFTs was assessed using Pearson and Spearman correlation coefficient. *P* < 0.05 were considered to be significant.

RESULTS

In total, 85 asthmatic patients (37 male and 48 female) aged 43.9 ± 10.61 years were participated. The median of asthma duration was 6 (3–14.5) years. Demographic information is shown in Table 1.

The mean, minimum and maximum of anthropometric measurements and pulmonary function variables are shown in Table 2. Hence, according to their BMI, 36.5% normal weight, 37.6% overweight and 23.5% obese were.

Comparing of all anthropometric measurements except height between three groups of BMI indicated statistically significant differences [Table 3].

Table 1: Demographic characteristics of the study participants (*n*=85)

Characteristics	Frequency	Percentage
Sex (female)	48	49
Married	78	91.8
Education		
Illiterate	18	21.2
Literacy	67	78.8
Habitat		
City	64	75.3
Village	21	24.7
Job		
Student	1	1.2
Housekeeper	42	49.4
Worker	2	2.4
Employer	4	4.7
Without job	1	1.2
Farmer/rancher	5	5.9
Other	30	35.3
Family history of asthma		
Yes	36	42.4
No	48	56.5
Exposure to cigarette (inactive)		
Yes	29	34.1
No	55	64.7

Table 2: Mean (SD), minimum and maximum of anthropometric and lung function variables for the all participants (*n*=85)

Variable	Mean (SD)	Minimum	Maximum
Weight (kg)	70.1 (10.28)	48.00	93.00
Height (cm)	162.6 (9)	144.00	185.00
BMI (kg/m²)	26.7 (4.47)	17.96	40.63
WC (cm)	95.1 (11.8)	60.00	123.00
HC (cm)	101.8 (8.28)	70.00	123.00
WHR	0.93 (0.09)	0.71	1.23
PEF (% predict)	78.28 (32.15)	21.00	150.00
FEV_1 (% predict)	79.05 (25.94)	23.00	140.00
FVC (% predict)	88.92 (21.4)	39.00	136.00
FEV_1/FVC%	73.57 (10.45)	47.06	95.88

The values are mean (SD). BMI=Body mass index, WC=Waist circumference, HC=Hip circumference, WHR=Waist-to-hip ratio, PEF=Peak expiratory flow, FVC=Forced vital capacity, FEV_1=Forced expiratory volume in 1 s, FEV_1/FVC%=Ratio of FEV_1 to FVC, SD=Standard deviation

No significant association between BMI and PFTs was observed. PEF and FVC were significantly correlated only with WHR. In addition, the results showed negative significant correlations between WC with FEV_1, PEF, FVC and FEV_1/FVC in overweight females. On the other hand, HC had inverse significant correlations with FEV_1 and FVC only in overweight females. Furthermore,

negative correlation between WHR with FEV_1, PEF and FVC in obese females were obtained [Table 4].

DISCUSSION

The present study aimed to explore the influence of anthropometric measurements on pulmonary function parameters patients with asthma.

In our study, not WC but WHR had an inverse significant relationship with lung function tests like many other studies[7] and this appears to be so more in females, unlike other studies.[7] Canoy et al. found significant relations of WHR with FVC and FEV in both men and women.[8] In a recent cross-sectional study in Chile, neither BMI nor WC was related to asthma symptoms in 1232 of adults.[9] In return, in a community-based study in Sweden, Kronander et al. showed that both BMI and WC were correlated with increased risks for asthma incidence and symptoms,

especially in nonatopic.[10] Chen et al. investigated the effect of WC on PFTs in three groups of people with normal weight, overweight, and obesity. They found that there were negative significant relationships between WC with FEV_1 and FVC.[11] This supports the hypothesis that an excess of abdominal fat and thoracic region may limit movements of the diaphragm and decrease compliance of the respiratory system.[12] To the effect, obese subjects with asthma who lose large amounts of weight have been shown to experience better conditions for control of their asthma symptoms.[13]

Adipose tissue is metabolically active and has proinflammatory effects because it secretes a range of substances such as adipose-derived hormones or adipokines.[14] Leptin, resistin, and adiponectin are examples of adipokines whose receptors are widely distributed throughout the body, like lungs. Leptin and resistin are increased in obesity and have pro-inflammatory effects, including activation of nuclear factor-kB, up-regulation of tumor necrosis factor α levels, and enhancement of neutrophilic airway inflammation.[15] In contrast, adiponectin is secreted inversely in obesity, and it is an anti-inflammatory adipokine that inhibits pro-inflammatory cytokines and induces anti-inflammatory cytokines.[16] So, adipose tissue – derived hormones may play an important role in managing asthma in obese persons.[15]

An important observation of the current study is sex differences, and hence that WC and HC in overweight females and WHR in obese females were negatively associated with the lung function variables, whereas there were any significant relationships in males. Several cross-sectional studies reported stronger associations between asthma and obesity in women than in men. Varraso et al. reported that BMI was associated with asthma severity in women but not men.[17] However, in a systematic review, the effect of WC on pulmonary function parameters was greater among males compared with females.[12] In the California Teachers Study cohort, obese and overweight women with asthma indicated more severe asthma episodes than normal weight women, as measured by more hospital admissions.[18] These sex differences between asthma and obesity relationship

Table 3: Comparison of anthropometric and lung function characteristics between BMI categories

Characteristic	Normal weight (BMI, 18.5-24.9 kg/m²)	Overweight (BMI, 25-29.9 kg/m²)	Obesity (BMI ≥30 kg/m²)
Number of subjects	33	32	20
Age (years)	42.24±12.38	43.19±10.11	46.5±7.79
Female sex, n (%)	13	17	18
Duration of asthma (years)	5 (3-15)*	7.5 (3-13)*	7.25 (4-18.75)*
Weight (kg)**	62.45±7.92	72.03±7.76	80±7.27
Height (cm)**	167.45±9.43	161.75±7.75	156.35±5.34
WC (cm)**	86.15±11.11	97.82±7.09	105.52±7.76
HC (cm)**	96.30±8.59	102.51±4.22	109.75±5.48
WHR**	0.9±0.10	0.95±0.07	0.96±0.09
PEF (% predict)	76.91±27.96	85.41±34.64	69.15±33.45
FEV_1 (% predict)	75.91±23.93	83.56±28.79	77±27.56
FVC (% predict)	86±17.95	91.53±24.62	89.55±21.59
FEV_1/FVC%	72.68±11.99	75.46±9.85	72.02±8.51

Values are presented as mean±SD. *Values are presented as median (percentile 25 to percentile 75). **There were significant differences among groups by one-way ANOVA. P<0.05 was considered as statistically significant. BMI=Body mass index, WC=Waist circumference, HC=Hip circumference, WHR=Waist-to-hip ratio, PEF=Peak expiratory flow, FVC=Forced vital capacity, FEV_1=Forced expiratory volume in 1 s, FEV_1/FVC%=Ratio of FEV1 to FVC, SD=Standard deviation

Table 4: Correlations between anthropometric and lung function variables

Variable	FEV_1 (% predict)		PEF (% predict)		FVC (% predict)		FEV_1/FVC%		Duration of asthma (years)	
	P	r	P	r	P	r	P	r	P	r
BMI (kg/m²)	0.92	0.01	0.45	−0.08	0.64	0.05	0.79	−0.03	0.15	0.16
WC (cm)	0.19	−0.14	0.06	−0.2	0.26	−0.12	0.27	−0.12	0.01	0.27*
HC (cm)	0.7	0.04	0.99	0.002	0.44	0.08	0.99	−0.001	0.48	0.08
WHR	0.06	−0.21	0.02	−0.25*	0.049	−0.21*	0.19	−0.14	0.01	0.27*

*P<0.05 was considered as statistically significant. BMI=Body mass index, WC=Waist circumference, HC=Hip circumference, WHR=Waist-to-hip ratio, PEF=Peak expiratory flow, FVC=Forced vital capacity, FEV_1=Forced expiratory volume in 1 s, FEV_1/FVC%=Ratio of FEV1 to FVC

could suggest that estrogen and other sex hormones may play an important role through modulation of Th_2 cytokine production. Then, estrogen may influence on airway responsiveness, immune cells or inflammatory processes.[13,18] Moreover, these relationships were found in females are probably associated with a comparable increase in overall muscles of males.[11] On the other hand, the negative correlation between the PFTs, WHR and HC may be due to the gynoid fat distribution in females versus android fat distribution in males. Nevertheless, these findings ensure further investigation and serve to highlight further the differences in the effects of body composition on respiratory function between two genders.

A major limitation of this study was an inadequate sample size of asthmatic patients. Therefore, our analysis could not obtain enough statistical power, and a larger population study is needed to confirm these influences. The other shortcoming of this study is if underweight patients were recorded in the study, we could compare their information with other groups and present more comprehensive information. Another limitation was about BMI for determining of obesity. However, BMI has been widely used as the standard index of obesity in a variety of studies, but it seems less efficient.[13] A major limitation of BMI is that it does not distinguish fat mass and muscle mass, while they have different effects on pulmonary function. Moreover, another limitation of BMI is that it provides no information on body fat distribution.[11] So, we used some other anthropometric measurements along with BMI in this study.

CONCLUSIONS

Our study found that pulmonary function was affected by some anthropometric measurements especially in overweight and obese women. These findings particularly reflect that this effect is influenced by the amount and distribution of body fat.

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