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ARAŞTIRMA / RESEARCH

Relationship between pulmonary function and anthropometric measurements and body composition in young women

Sağlıklı genç kadınlarda solunum fonksiyon testleri ile antropometrik ölçümler ve vücut bileşimi ilişkisi

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Abstract

Purpose: This study was planned to evaluate the relationship between pulmonary function and some anthropometric measurements and body composition in healthy young women with different body mass index (BMI).
Materials and Methods: One hundred seventeen (n:117) women, aged between 19-30 years, participated in this study. Some anthropometric measurements of the participants (body weight, height, waist circumference, hip circumference, and neck circumference) and body composition were evaluated by the researchers.
Results: There was no difference in forced vital capacity (FVC), forced expiratory volume in 1 second (FEV_1) and FEV_1/FVC values of individuals according to BMI classification. In terms of disease risk according to anthropometric measurements, no difference was found between the groups in the pulmonary function test values (except for the waist circumference). Participants whose waist circumference were 80-88 cm were found to have a significantly higher FEV_1/FVC value than participants whose waist circumference were >88 cm. It was determined that there was a positive correlation between body weight, lean body mass, body fat mass, total body water values, and FVC, FEV_1 values.
Conclusion: Differences in body composition and anthropometric measurements and pulmonary function assessment may be due to methodological and group-specific changes in the studies. Long-term studies that question the body composition of individuals, food consumption and physical activity levels, will be beneficial.
Keywords:. Pulmonary function, anthropometric measurements, body composition

Öz

Amaç: Bu çalışma, farklı beden kütle indeksine (BKİ) sahip genç kadınlarda solunum fonksiyon testleri ile bazı antropometrik ölçümler ve vücut bileşimi arasındaki ilişkinin değerlendirilmesi amacıyla planlanmıştır.
Gereç ve Yöntem: Çalışmaya yaşları 19-30 yaş arasında olan 117 kadın dahil edilmiştir. Katılımcıların bazı antropometrik ölçümleri (vücut ağırlığı, boy uzunluğu, bel çevresi, kalça çevresi ve boyun çevresi) ve vücut kompozisyonu araştırmacılar tarafından değerlendirilmiştir.
Bulgular: Bireylerin BKİ sınıflamasına göre zorlu vital kapasite (FVC), 1. saniye zorluekspiratuvar volüm (FEV1) ve FEV1/FVC değerlerinde fark yoktur. Solunum fonksiyon testi değerlerinde (bel çevresi hariç) antropometrik ölçümlere göre hastalık riski açısından gruplar arasında fark bulunmamıştır . Bel çevresi 80-88 cm olan bireylerin FEV1/FVC değeri, bel çevresi >88 cm olan bireylere göre anlamlı olarak daha yüksek bulunmuştur. Vücut ağırlığı, yağsız vücut kütlesi, vücut yağ kütlesi ve toplam vücut suyu değerleri ile FVC, FEV1 değerleri arasında pozitif bir ilişki olduğu belirlenmiştir.
Sonuç: Vücut kompozisyonu ve antropometrik ölçümler ile solunum fonksiyon değerlendirmesindeki farklılıklar, çalışmalardaki metodolojik ve gruba özgü değişikliklerden kaynaklı olabilir. Bu nedenle bireylerin vücut bileşimlerinin yanı sıra, besin tüketimi ve fiziksel aktivite düzeylerinin sorgulandığı uzun süreli çalışmaların faydalı olacağı düşünülmektedir.

Anahtar kelimeler: Solunum fonksiyonu, antropometrik ölçümler, vücut kompozisyonu

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INTRODUCTION

Respiratory function and lung capacity is a condition that can be affected by many factors such as individuals' disease status, age, gender, body weight and environment[1]. Body weight is an important factor that can affect the strength and resistance of respiratory muscles, gas exchange in the lungs, breathing control and exercise capacity, as in many health-related conditions. Both obesity and underweight can affect respiratory functions. However, the effect of abdominal obesity especially is quite obvious on respiratory functions[2,3].

Obesity may cause dyspnea, increased cardiac load, increased load on the respiratory muscles in the diaphragm and thoracic wall, decreased gas exchange and exercise capacity in the lung[2,3]. In particular, intra-abdominal adipose tissue, which accumulates in the chest and abdominal cavity, compresses the thorax, diaphragm and lungs and reduces the respiratory capacity [4]. As a result, the motion area of the diaphragm narrows and the chest cavity decreases that cause lung capacity to not be fully utilized[4]. Also, the increasing in cytokine production causes the pro-inflammatory process to be triggered and an increasing in airway resistance in obese individuals[5,6].

Pulmonary function test is a parameter which associated with the respiratory system diseases. Spirometry test is the most frequently used method to evaluate lung respiration performance[7]. Also, forced vital capacity (FVC), forced expiratory volume in 1 second (FEV_1) and total lung capacity (TLC), obtained from the pulmonary function test results, are significantly lower in individuals with higher abdominal adiposity. Similarly, FVC and FEV_1 were low in underweight individuals [8]. Studies have found that increased body mass index (BMI) and waist circumference are associated with a decreasing in FVC, FEV_1 and FEV_1/FVC[1,4]. There are also studies showing that there is a relationship between waist circumference and pulmonary functions. However, there isn't any relationship between BMI and pulmonary functions[9,10]. On the other hand, low lung capacity has also been shown to be associated with increased body weight [9] and high body fat percentage[11] among different BMI groups.

The relationship between anthropometric adiposity parameters and respiratory functions is not yet clear[12]. In addition, there is no clear evidence as to which of the body weight, BMI, body fat tissue, waist circumference, waist/hip ratio, neck circumference, waist/height ratio is a good indicator in evaluating the results of respiratory functions[13]. Many studies have shown that obesity has an impact on lung function [5,6,14] but its relationship with weakness is questionable[15]. This study was planned to evaluate the relationship between respiratory function tests and some anthropometric measurements and body composition in healthy young women with different BMI.

MATERIALS AND METHODS

The study was carried out with the students of Gazi University Faculty of Health Sciences. The study protocol was approved by the Ethics Committee at the Gazi University (05.08.2018 date and issue number 04). In the study conducted on a voluntary basis, the volunteer consent form was signed to the people who will participate in the study. In this study, women between the ages of 19-30 years without any chronic diseases and no smoking were included and data were collected by face-to-face interview method.

Power analysis was carried out using G power software to determine the number of participants in the sample before starting the study. As a result, the number of samples was calculated as at least 30 people in each group as underweight (<18.5 kg / m^2), normal (18.5 - 24.9 kg / m^2) and overweight (25 - 29.9 kg / m^2) according to BMI classification (error type 1 (alpha)=0.05, test power (1-error type 2 (beta)=0.80 and margin of error (d) =0.20). The present study of 117 participants which were, 34, 51 and 32, respectively, from each BMI group.

Anthropometric measurements

The body weight, height, waist circumference, hip circumference and neck circumference of participants were taken by the researchers according to technique [16]. Bioelectrical impedance analysis (BIA) method was used to determine the body composition (body fat mass (kg), body fat percentage (%), lean body mass (kg), total body water (kg)) and measurements were taken with the TANITA BC-418.

Body mass index was calculated for each participant based on height and body weight measurements. BMI was calculated using the formula: Body mass (kg) / height (m^2). The BMI classification of the participants was made according to the World Health Organization (WHO) BMI classification (underweight (<18.5 kg/m^2), normal (18.5 - 24.9 kg/m^2) and overweight (25 - 29.9 kg/m^2) [17].

Waist circumference, waist/hip ratio and waist/height ratio and neck circumference are important in evaluating the risk of chronic disease and obesity [18-20]. According to WHO, waist circumference classification has been evaluated as normal below 80 cm, risk above 80-88 cm and high risk above 88 cm. Also, waist-hip ratio was classified as risk at 0.85 and above [18]. Besides, the cut-off point was taken as 0.5 to evaluate waist/height ratio. There is no risk, if the value is below 0.5 but if it is above 0.5, it is considered as risk [19]. Neck circumference was evaluated as no risk below 34 cm, and above 34 cm as risk [20].

Respiratory function test

Respiratory function tests of participants were done by a researcher who had received device training with a spirometer (Cosmed-MicroQuark) and the results were recorded. All spirometer measurements were taken in a sitting position as suggested by the American Thoracic Society (ATS) [21]. During the measurement, the participants' noses were closed with a clip, allowing them to breathe through the mouth. The tip of the spirometer was placed in the mouth, after the participants exhaled three times normally, they took the fastest breath they could get and exhaled it until the very last radical. As a result of the measurement, the FVC and FEV_1 values of the participants were obtained. Also, the FEV_1/FVC value, which is obtained by proportioning the FEV_1 and FVC values, is expressed.

Statistical analysis

Statistical analyses were evaluated in SPSS 22.0 software. Depending on distribution of data and the number of groups, ANOVA, Kruskal-Wallis test and independent T test were used in comparisons between groups. Spearman correlation test was used to evaluate the correlation between anthropometric measurements and pulmonary function test data. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Anthropometric measurements, body composition and respiratory test results of individuals according to BMI groups was shown in Table 1. The mean age of individuals was 20.8±2.41 years and the ages of the groups were determined to be similar according to the BMI groups (p>0.05). When the body composition and anthropometric measurements of individuals were evaluated according to BMI groups, the measurements of the three groups were statistically different (p<0.001). There was no statistically significant difference in FVC, FEV1 and FEV1/FVC values of individuals among BMI groups (p>0.05) (Table 1).

Table 1 Anthropometric measurements, body composition and respiratory results of individuals according to BMI

	Underweight (n:34)	**Normal (n:51)**	**Overweight (n:32)**	***P* Values**
Age (year)	20.2±1.81	20.9±1.86	21.4±3.44	0.087
Height (cm)	163.4±5.67	162.6±6.49	163.1±5.19	0.793
Weight (kg)	46.7±3.30[a]	55.8±6.21[b]	74.5±10.54[c]	<0.001*
Lean body mass (kg)	38.1±2.44[a]	41.6±3.58[b]	47.1±3.91[c]	<0.001*
Body fat mass (%)	18.4±3.67[a]	25.2±3.85[b]	36.3±4.58[c]	<0.001*
Body fat mass (kg)	8.6±2.01[a]	14.2±3.41[b]	27.4±7.52[c]	<0.001*
TBW (kg)	27.9±1.78[a]	30.4±2.62[b]	34.5±2.86[c]	<0.001*
Waist circumference (cm)	66.9±4.42[a]	72.8±4.93[b]	89.6±8.68[c]	<0.001*
Hip circumference (cm)	87.8±3.95[a]	95.9±3.82[b]	108.2±8.42[c]	<0.001*
Neck circumference (cm)	30.4±1.31[a]	31.7±1.32[b]	34.2±1.76[c]	<0.001*
Waist/hip ratio	0.7±0.04[a]	0.7±0.03[b]	0.8±0.10[c]	<0.001*
Waist/height raio	0.4±0.03[a]	0.4±0.03[b]	0.5±0.05[c]	<0.001*
FVC (L)	3.8±0.27	3.7±0.35	3.8±0.25	0.747
FEV_1 (L)	3.3±0.24	3.3±0.33	3.3±0.21	0.867
FEV_1/FVC (%)	85.2±0.38	84.9±1.43	85.0±0.66	0.112

*p<0.01, Different letters show the difference among groups. FEV_1: forced expiratory volume in 1 second, FVC: Forced vital capacity, TBW: Total body water

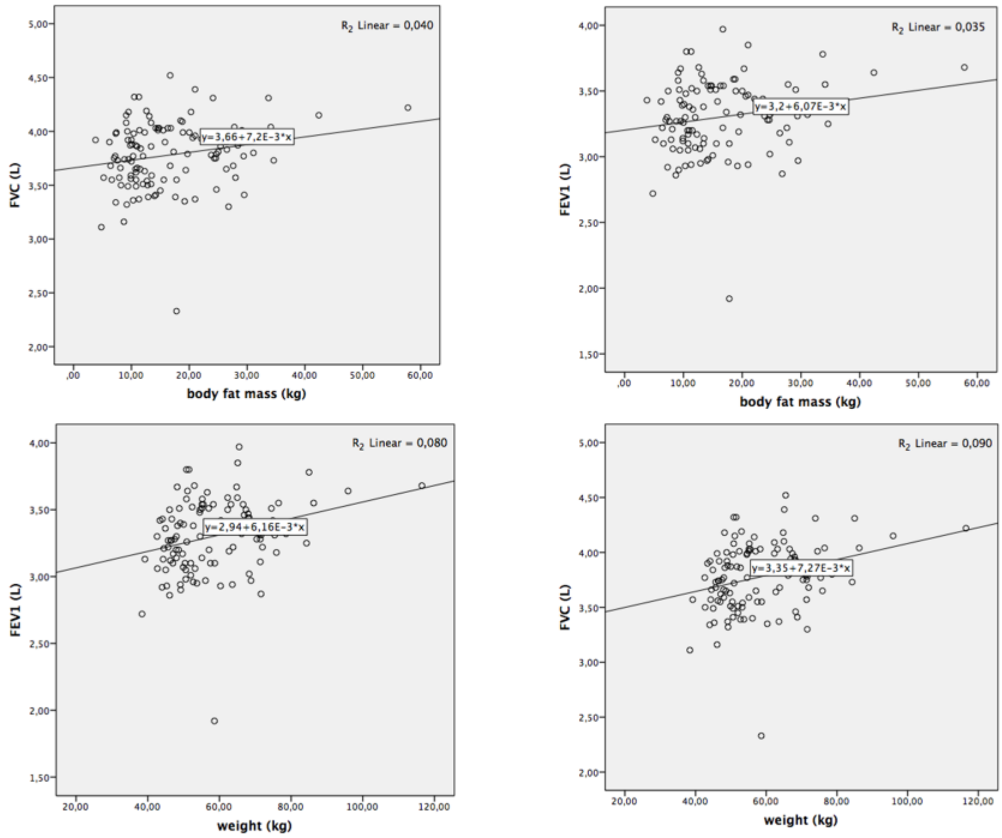

Figure 1. The graphs indicate correlation of FVC and FEV_1 with body weight and body fat mass.

FEV1: forced expiratory volume in 1 second, FVC: Forced vital capacity.

Table 2. The respiratory test results of individuals according to disease risk classification of anthropometric measurements

	FVC (L)	FEV_1 (L)	FEV_1 / FVC (%)
Neck circumference			
< 34 cm	3.7±0.31	3.3±0.28	85.1±1.01
≥ 34 cm	3.9±0.27	3.4±0.23	84.9±0.72
P Values	0.053	0.132	0.830
Waist circumference			
< 80 cm	3.7±032	3.2±0.29	85.1±1.15^{ab}
80-88 cm	3.9±0.27	3.4±0.22	85.4±0.23^{a}
>88 cm	3.7±0.25	3.3±0.23	84.7±0.7^{b}
P Values	0.204	0.331	0.026*
Waist / hip ratio			
< 0.85	3.8±0.32	3.3±029	85.1±1.08
≥ 0.85	3.7±0.25	3.2±0.22	84.7±0.73
P Values	0.333	0.343	0.195
Waist / height ratio			
<0.5	3.7±0.32	3.3±0.29	85.1±1.15
≥0.5	3.7±0.28	3.2±0.24	85.0±0.6
P Values	0.994	0.756	0.806

*p<0.05, Different letters show the difference between groups. ;FEV_1: forced expiratory volume in 1 second, FVC: Forced vital capacity

The respiratory test results of individuals according to disease risk classification of anthropometric measurements was given in Table 2. In terms of disease risk, no difference was found between the groups, except for the waist circumference, in the pulmonary function test values ($p>0.05$). FEV_1/FVC value of individuals with waist circumference of 80-88 cm was found significantly higher than individuals with >88 cm ($p<0.05$).

The correlation between anthropometric measurements and respiratory test results was shown in Table 3. It was determined that there was a positive correlation between body weight, lean body mass, body fat mass and total body water values and FVC and FEV_1 values ($p<0.05$) (Table 3). Also, the correlation graphs of FVC and FEV_1 with body weight and body fat mass were given in Figure 1.

Table 3. The correlation between anthropometric measurements and respiratory test results

	FVC (L)	FEV_1 (L)	FEV_1 / FVC (%)
Weight (kg)	0.310**	0.307**	-0.035
BMI (kg/m^2)	-0.033	-0.035	-0.086
Lean body mass (kg)	0.470**	0.463**	0.038
Body fat mass (%)	0.123	0.129	-0.091
Body fat mass (kg)	0.191*	0.198*	-0.069
TBW (kg)	0.469**	0.462**	0.038
Waist circumference (cm)	0.111	0.100	-0.058
Neck circumference (cm)	0.166	0.158	-0.034

* Significance level at 0.05 level on two tailed **Significance level at 0.01 level on two tailed; BMI: Body mass index; FEV1: forced expiratory volume in 1 second, FVC: Forced vital capacity, TBW: total body water

DISCUSSION

Increased body weight is a risk factor for many diseases such as diabetes, cardiovascular diseases, and respiratory diseases [22]. Obesity affecting respiration, chest wall, abdomen and upper airway. Especially, adiposity in the chest and abdominal areas limit the movement of the chest wall [6]. Also, obesity can negatively affect respiratory system by changing gas exchange, respiratory mechanism and control [14]. In this study, BMI, body fat and abdominal obesity parameters (waist circumference, waist/hip ratio, waist/height ratio) were evaluated and their effects on respiratory functions were examined. The relationship between BMI and pulmonary function in the literature is not clear. There are different results in studies such as FEV_1/FVC increases with increasing BMI [23], FEV_1/FVC isn't affected by BMI [24] or FEV_1/FVC decreases with increasing BMI [1,15]. However, in these studies, evaluation of body composition and abdominal fat were not included and it was stated as study limitation [1,15,23,24]. In present study, no significant relationship was found between BMI and FVC, FEV_1 and FEV_1/FVC. It is thought that carrying out studies on respiratory functions that not only BMI but also body composition parameters such as body fat and lean mass will reveal more clear results.

Besides obesity, underweight also affects pulmonary function [15,24]. It was showed that FEV_1 and FVC values are lower in underweight individuals than obese individuals. On the contrary, they found FEV_1/FVC was higher in the underweight individuals [15]. In another study, it was reported that FEV_1, FVC and PEF values were lower in underweight individuals compared to individuals with normal body weight [24]. In this study, although no significant difference was observed between the BMI groups in pulmonary function values (FVC, FEV_1, FEV_1/FVC). Similarly, low pulmonary function (FEV_1 and FVC) is known to be associated with low muscle tissue [25,26] and this relationship may be due to the low diaphragm muscle [27]. In this study, the positive correlation between lean body mass and FEV_1 and FVC values confirm this situation. In the longitudinal study carried out, it was stated that individuals with low BMI (BMI <21.3 kg/m^2) had lower respiratory function at the beginning of the study compared to individuals with high BMI (BMI≥26.4 kg / m^2) [23]. At the end of the decade, it was observed that in low BMI group FVC and FEV_1 increased by 71 mL and 60 mL respectively, whereas the FVC decreased by 185 mL and the FEV_1 decreased by 64 mL in the high BMI group [23]. However, in this study, unlike our study, 21.3 kg/m^2 was taken as cut off in low BMI group. It is thought that the results may change due to the different classification of BMI in studies.

The lean body mass, fat mass and height were important determinants of lung volumes and associated with pulmonary function [28]. Obese individuals may have smaller caliber airways due to excess body adipose tissue, which may lead to decreased airway flow [15,29]. In a study, while total body fat and abdominal obesity were negatively related to pulmonary function, increased lean mass was related with lower lung function and FEV_1/FVC [30]. Similarly, Ogunlana et al. reported that the fat mass of the participants had a significant negative correlation with lung function variables except FVC, whilst the FFM had a significant moderate positive correlation with FVC and FEV_1 [28]. In another study, although individuals are of normal body weight, increased body fat mass affected pulmonary function (FEV_1 and FVC) negatively. Also, a positive correlation was found between body fat and lean mass and FVC and FEV_1 values [29]. In this study a significant positive correlation was found between body fat and lean mass (kg) and FVC and FEV_1 values. This may be due to the fact that the individuals who participated in this study had more lean body mass than participants in other studies. In addition, studies show a positive correlation between increased lean body mass and respiratory functions [31].

The relationship between anthropometric adiposity parameters and respiratory functions is contradictory [12]. It has been shown that there is a relationship between waist circumference, which is one of the parameters of abdominal obesity, and pulmonary functions [9,10]. In a study, waist circumference and hip circumference showed significant weak negative correlations with FEV1/FVC ratio [28]. Besides, Ishikawa et al showed that the anthropometric and body composition parameters were negatively associated with FVC and FEV1 [32]. In this study no correlation was found between waist circumference, neck circumference and pulmonary function test values. The data of evaluating disease risk and pulmonary function based on anthropometric measurements are limited. In present study, the FEV_1/FVC of those with normal waist circumference (80-88 cm) was found to be significantly higher than who has a high risk of disease (>88 cm) ($p<0.05$). In evaluating the results obtained on respiratory functions, there is no clear information about which body weight, BMI, body fat tissue, waist circumference, waist / hip ratio, neck circumference, waist / height ratio is a good indicator [13]. In the future, it will be beneficial to plan a longitudinal and follow up studies that will examine the effect of anthropometric measurements on pulmonary function.

As a result, it has been observed in the literature that there are different results in studies evaluating respiratory functions and anthropometric measurements and body composition. The methodological and group-specific changes seen in the studies may be effective in these differences. Limitation of this study is that it was conducted only on women in a certain age range. One of the limitations of the study is that BIA was used in body analysis. The use of DEXA, which is the gold standard in the evaluation of the body composition, may give more reliable results than BIA. Another limitation of the study is that the food consumption or physical activities of the participants were not questioned. In addition to evaluating the body composition of individuals, it is thought that longitudinal studies that question food consumption and physical activity levels will be more beneficial.

Yazar Katkıları: Çalışma konsepti/Tasarımı: HY, EK, FA, BA; Veri toplama: FA, BA; Veri analizi ve yorumlama: FA, BA; Yazı taslağı: HY, EK, FA, BA; İçeriğin eleştirel incelenmesi: HY,EK; Son onay ve sorumluluk: HY, EK, FA, BA; Teknik ve malzeme desteği: HY, EK; Süpervizyon: HY, EK; Fon sağlama (mevcut ise): yok.
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