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Respiratory function does not affect by a single bout cycling in obese men

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Key words: Asthma, spirometry, immunoglobulin E.

Abstract

Asthma and obesity are both increasing concomitantly, suggesting that these factors may be causally related. However, the precise mechanisms of any association between them are not completely understood. Our aim was to verify whether a single bout exercise could improve respiratory functional in obese men. For this purpose, nineteen untrained middle-aged obese men were completed a single bout cycling exercise, and underwent a spirometry test before and after exercise in order to determine effect acute exercise on FEV, FVC, FEV/FVC and the other spirometry parameters. No significant differences were found in all spirometry parameters by cycling exercise with compared to baseline. A short-term exercise intervention can not induce favorable changes in respiratory functional in none-asthma obese men.

Key words: Obesity, asthma, respiratory function.

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Introduction

Review of research evidence shows that the prevalence of asthma and obesity are both increasing concomitantly, suggesting that these factors may be causally related (ACSM, 1998). Asthma and obesity are both important current public health problems; however, the specific mechanisms responsible for these observations are not obvious. On the other hand, a large body of evidence suggests that there is a gradual age related decline in the pulmonary function beginning at about age forty. It is generally accepted that forced expiratory volume in 1 second (FEV1) and Forced vital capacity (FVC) are strong indicators of lung function, which decline due to obesity and sedentary life style (Inselma *et al.,* 1993; Jakes *et al.,* 2002). Also, some authors noted that impaired respiratory function such as forced expiratory volume in one second (FEV1) is strongly related with cardiovascular risk factors, atherosclerosis, arterial stiffness, cardiovascular disease and mortality, although the mechanisms underlying this response are a matter of some debate (Zureik *et al.,* 2001). Review of research evidence shows that aging or obesity combined with sedentary lifestyles has a direct effect on the function of respiratory system by altering lung volume, airway caliber and respiratory muscle strength (Inselma *et al.,* 1993). On the other hand, physical activity has been known to improve physical fitness and to reduce morbidity and mortality from numerous chronic conditions (US Department, 2002). Nowadays, most studies on the effects of physical activity on respiratory function are cross sectional ones on special populations such as athletes or respiratory diseases such as asthma or chronic obstructive pulmonary disease (COPD).

On the other hand, although low levels of pulmonary function or reduced spirometric indices in obese patients are not supported by all studies; most sources indicate decrease in respiratory function in obese individuals. Although the values of spirometric indices in obese people are not identical with asthmatic patients increased obesity appears to be associated with asthma and further reduced respiratory function. These findings are some way indicate that obese people somehow are prone to asthma or other respiratory diseases (Boulet, 2008). Hence, development of appropriate strategies for preventing the phenomenon of asthma in obese individuals is the focus of health sciences researchers.

Exploration of the effect physical activity and cardiovascular and respiratory functions will aid in understanding the mechanisms of how physical activity improves patients' quality of life and in finding a better way to evaluate effects of rehabilitation. In this area, the role of long-term exercise training on respiratory functional or spirometry indexes on asthma patients or obese subjects it strongly supports by some studies (Radovanovic *et al.,* 2009; Courteix *et al.,* 1997; Khalili *et al.,* 2009). But, whether a single bout exercise affects the spirometry markers in obese subject with none-asthma have not been well studied. Therefore, this study was performed to determine spirometry indexes responses to an acute exercise in middle-aged obese males.

Material and methods

Subject

The aim of our work was to study the effect of single bout cycling exercise on some spirometry parameters as respiratory functional in obese men. The study protocol was approved by Islamic Azad University, Iran. Nineteen middle-aged obese men (37.4 ± 5 years mean ± standard deviation) participated in the study. All subjects were otherwise in good health were taking no medications. All subjects had a body mass index (BMI) greater than 30 kg/m^2. Each participant received written and verbal explanations about the nature of the study before signing an informed consent form. Participants were included if they had not been involved in regular physical activity/diet in the previous 6 months. Subjects included individuals with no cardiovascular diseases, gastrointestinal diseases, kidney and liver disorders or diabetes. We also excluded people who had any self reported physician diagnosed chronic disease (arthritis, stroke, hypertension, cancer, heart attack, chronic cough, or bronchitis, asthma, COPD). In addition, exclusion criteria included inability to exercise and supplementations that alter carbohydrate-fat metabolism.

Table 1. Baseline characteristics of anthropometrical parameters of studied subjects.

Variable	Mean	Standard deviation	Range
Age (years)	37	6	35-43
Weight (kg)	103	11	90-114
Height (cm)	174	7	170-1781
Body mass index (kg/m²)	34	3	30 - 36
Body fat (%)	32	4	29 - 35
Abdominal circumference (cm)	109	11	100 - 121
Hip circumference (cm)	108	9	100 - 119
WHO	1.01	0.08	0.97 – 1.07
Systolic blood pressure (mmHg)	129	19	117-146
Diastolic blood pressure (mmHg)	87	8	78-92

Anthropometric measurements

The measurements for weight, height, abdominal and hip circumference and blood pressure were first performed. The weight and height of the participants were measured in the morning, in fasting condition, standing when the participant had thin clothes on and was wearing no shoes by using the standard hospital scales. Abdominal circumference was measured midway between the 10th rib and the top of the iliac crest at the end of a normal expiration, using a non-stretchable tape measure. Hip circumference was measured in the most condensed part using a non-elastic cloth meter. Also, Waist to hip circumference ratio (WHO) was calculated through dividing the abdominal circumference by hip circumference. Visceral fat and body fat percentage was determined using body composition monitor (OMRON, Finland). BMI was calculated as weight (kg)/height (m2).

Table 2. Mean and standard deviation of the changes in all spirometry parameters following exercise test.

Variables	Pre-exercise	Post-exercise
FVC %	97 ± 9	99 ± 7
FEV1 %	95 ± 6	97 ± 7
FEV1/FVC %	83 ± 6	86 ± 7
PEF %	100 ± 9	106 ± 10
FEF %25 / %75	95 ± 8	96 ± 9
EVC %	103 ± 11	100 ± 8
FEF %75	94 ± 7	96 ± 10

FEV1: forced expiratory volume in 1 s, **FVC**: forced vital capacity,
FEV1/FVC: forced expiratory volume in 1 s / forced vital capacity
PEF: Peak expiratory flow, **EVC**: Expiratory vital capacity

Blood sampling and exercise program

After anthropometric measurements, respiratory function was measured by resting spirometry test before and after cycling exercise. The subjects were advised to avoid any physical activity or exercise 48 hours before the blood sampling. Subjects were asked to refrain from tea, coffee, chocolates and caffeinated soft-drinks on the day of recording Spirometry. Subjects were instructed to take maximum inspiration and blow into the pre-vent pneumotach as rapidly, forcefully and completely as possible for a minimum of 6 seconds, followed by full and rapid inspiration to complete the flow volume loop. The best of the three trials was considered for data analysis. Calibration of spirometer and all testing protocols were performed as outlined in the instruction manual of the spirometer. Spirometry was performed before and half hours after cycling exercise and respiratory symptoms (FVC, FEV1, and FEC1/FVC) were recorded. Cycling exercise test was a YMCA standard test on leg ergometery cycle (Tunturi, made in Finland). This protocol was performed in 5 continues stage without rest between stages. Each stage lasted 3 minute (Mullis *et al.,* 1999).

Statistical analyses

Statistic analysis was done with SPSS 15.0 for Windows. Normal distribution of data was analyzed by the Kolmogorov-Smirnov normality test. Student's t-tests for paired samples were performed to determine significance of changes in variables by exercise test in studied subjects. Significance was accepted at $P < 0.05$.

Results

Baseline characteristics of anthropometrical parameters such as age, body weight, BMI, body fat percentage and systolic and diastolic blood pressure are shown in Table 1. All values are represented as mean ± SD. Kolmogorov-Smirnov test showed that the variables are in normal distribution. This data indicate that all participants are obese.

Table 2 shows the changes in all spirometry parameters following exercise test. FEV1 levels were significantly increased in response to acute exercise when compared with baseline levels ($P < .05$). Moreover the other spirometry parameters such as FVC, FEVI/FVC showed a significant improvement by cycling exercise in studied subjects ($P < .05$). A statistically significant correlation was observed between the changes in FEV1 and FVC by exercise test ($p = 0.021$, $r = 0.57$).

Discussion

Our finding showed that a submaximal exercise cycling does not affect respiratory functional in obese men. Based on this data, it was concluded that a single bout exercise is not associated with improvement in spirometry markers in none-asthmatic obese subjects. While increased respiratory functional by exercise even a session has repeatedly been reported in patients with asthma. On the other hand, it has been demonstrated that obesity to be related to allergy symptoms or to higher serum IgE levels (a marker for atopy) (Schachter *et al.,* 2003; Xu *et al.,* 2000) whereas others have not (Tantisira *et al.,* 2003; Chen *et al.,* 2006). Several studies have shown an association between obesity and asthma (Chinn *et al.,* 2003; Huovinen *et al.,* 2003; Stanley *et al.,* 2005). Although the physiopathological mechanisms underlying these associations are largely unknown. One possibility is that obesity and allergy share common risk factors such as sedentary lifestyle and dietary factors. A second possibility is that obesity can have a signigcant effect on normal lung physiology by reducing chest wall compliance (Shore *et al.,* 2005). As a third possibility, accumulating evidence has implicated systemic changes in immune function in the development of obesity; several obesity-related hormones and cytokines may lead to airway per responsiveness (Shore *et al.,* 2005[a]; Sood *et al.,* 2005; Shore *et al.,* 2005[b]). Some Recent epidemiologic studies have reported an association between increased body mass index (BMI) and asthma prevalence (Gennuso *et al.,* 1998; Figueroa-Munoz *et al.,* 2001). It has been hypothesized that impairment in pulmonary mechanics related to obesity increases airway resistance and gives way to dysfunction in small airways. On the other hand, asthma is a disease characterized by inflammation, and there is increasing evidence in the literature that the obesity is an inflammatory state (Visser *et al.,* 2001). The effects of increased BMI or obesity on asthma may be mediated by upregulation of inflammatory mechanisms in the airway epithelium. On the other hand, it has been hypothesized that aging is associated with decrease in alveoli number, and the cilia become less active, also, with inhalation the lung bases of the elderly do not inflate well and secretions are not expelled (Betglumd *et al.,* 1999). Additionally, According to the population studies, it has been indicated that there is a greater resistance to airflow due to narrowing of the bronchioles. The vital capacity (VC), FEV1, maximum voluntary ventilation (MVV) and peak expiratory flow (PEF)

decrease while the residual volume increases due to loss of elastic recoil, reduction in elasticity, air trapping, weakness of respiratory muscles, costal cartilage calcifies and ribs become less mobile.
FVC and FEV1 are strong indicators of lung function, which decline due to obesity and sedentary life style (Inselma *et al.,* 1993; Jakes *et al.,* 2002). FVC is the volume of the air that can be expired rapidly with a maximum force after a full inspiration. FEV1 is the volume expired in the first second during maximal expiratory effort after a maximal inspiration and is a useful measure of how quickly full lungs can be emptied. It has been demonstrated that FEV1 represents the volume of air expired in the first second of a FVC. Estimation of FEV1 is the most commonly used screening test for airway diseases. Normally FEV1 is about 80% of the FVC (Figueroa-Munoz *et al.,* 2001). Our study finding showed that the mean of baseline levels of FVC and FEV1 in studied subjects are 96 and 95% respectively. FEV1/FVC is the percentage of the vital capacity which is expired in the first second of maximal expiration. In healthy patients the FEV1/FVC is usually around 70%. But its level in asthma patients is 60%. In patients with obstructive lung disease FEV1/FVC decreases and can be as low as 20-30% in severe obstructive airway disease. The baseline level of FEV/FVC in our study was more than 80%.

There is considerable evidence that young overweight and obese subjects with sedentary life style are at a higher risk for deterioration of their respiratory indices and may be at risk for developing chronic obstructive pulmonary disease in adulthood (Ahmad *et al.,* 2011). It was reported that pulmonary rehabilitation program incorporating aerobic exercise training improves respiratory muscle function (Strength and endurance), pulmonary function test and six minute walking test (Normandin *et al.,* 2002). Hence, it seems that appropriate interventions, such as prescribed physical activity programs, may prevent lung function deterioration in obese subjects. In this are, a recent study showed that intensive swimming prepuberty enhances static and dynamic lung volumes (Cortex *et al.,* 1997). Another study reported that an 8-week program of aerobic exercise can improve lung function in children with intellectual disability (Khalili *et al.,* 2009). On the other hand, among obese males and females, a reduction in fat mass has been found to be associated with an increased lung volume (Sue, 1997).

The mechanisms by which physical inactivity might influence FVC and FEV1 are unclear. Nevertheless, so far very few studies have been conducted to explore the short-term effects of exercise particularly a single sub-maximal exercise session on obese individuals without clinical symptoms of respiratory disease. Most studies in this field are longitudinal and are often performed on patients with respiratory disease or on athletes. Although some studies have somehow noted a link between obesity and asthma, citing the findings of this study as well as those of other previous studies on obese subjects that have often been associated with weight loss it seems a single session exercise can not improve the respiratory function of non-asthmatic obese subjects. Because, although obese people have some kind of reduced levels of respiratory function than those with normal weight, according to baseline levels spirometric indices in obese patients in the present study it can be said that the decline in these indicators is not such so as be changed by a single exercise session. Some sources have also pointed to the fact that fat loss induced by prolonged exercise in obese individuals is associated with increased respiratory function (Sue, 1997). It seems that those exercise activities that are associated with a significant reduction in body weight in obese individuals are able to improve respiratory function. Additionally, it seems that excessive fat mass and short duration of the exercise training are probable mechanisms for insufficient respiratory functional improvements in this study.

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