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Relationship of Cardiorespiratory Fitness with Spirometrical markers in Asthma patients

Rasoul Mohammadi, Nasibeh Rezaei Afrapoli and Shahram Khanzadeh Holaso
Department of Physical Education and Sport Sciences,
Islamshahr Branch, Islamic Azad University, Islamshahr, IRAN

(Corresponding author: Rasoul Mohammadi)
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ABSTRACT: The prevalence of asthma or allergic diseases has noticeably increased worldwide. To analyze whether cardiorespiratory fitness is associated with Spirometrical markers such as forced vital capacity (FVC), forced expiratory volume in 1 s (FEV1) and FEV1/FVC in asthma patients, VO_2max a determinant of cardiorespiratory function and respiratory function test were performed by twenty eight sedentary adult men with chronic asthma (39 ± 3 years of old) that participated in study by accessible samples. Asthma patients were non-smoker and non-trained without a history of other chronic disease. Respiratory function was measured by spirometry. Relationship between VO_2max with other variables was determined by Pearson correlation method. Based on statistical analysis, we observed that VO_2max was positively correlated with FVC ($p = 0.013$, $r = 0.42$), FEV1 ($p = 0.005$, $r = 0.52$) and FEVI/FVC ($p = 0.003$, $r = 0.54$) in studied patient. In conclusion, it is suggest that increased aerobic capacity by exercise training can be respiratory function in asthma patients.

Keywords: Spirometry, Aerobic capacity, Respiratory diseases

INTRODUCTION

Asthma is a chronic inflammatory respiratory pathways disease in which, the sensitivity and resistance of the respiratory pathways reduce air intake into the lungs [1,2]. Increased smooth muscle of the respiratory pathways in response to certain inflammatory mediators is responsible for the narrowing of the pathways and symptoms such as cough, chest tightness, and wheezing [3]. Some researchers regard that as a health-threatening and the most prevalent chronic disease in children as its prevalence is increasing in most developed and developing countries [4].

Resistance of the respiratory pathways in the patients is associated with reduced lung volumes such as maximum vital capacity and MVV, and the reduced spirometric indicators of the lung function compared to the healthy individuals [5]. According to most studies, spirometric parameters, such as forced vital capacity (FVC), forced expiratory volume in 1 s (FEV1), and FEV1/FVC in these patients was lower compared to the healthy individuals [6]. On the other hand, patients have lower levels of cardiorespiratory fitness as some studies have revealed that asthma patients had lower levels of VO_2max, as an indicator of cardiorespiratory fitness, compared to the healthy individuals [7]. However, few studies reported no difference between these indicators in healthy subjects and patients with asthma [8]. VO_2max, or maximal oxygen uptake, is one factor that can determine an athlete's capacity to perform sustained exercise and is linked to aerobic endurance. VO_2max refers to the maximum amount of oxygen that an individual can utilize during intense or maximal exercise.

Most previous studies have somehow attributed the reduced cardiorespiratory fitness to the inflammatory profile in the chronic diseases and regarded the reduction as a reflection of increased chronic inflammatory cytokines in chronic diseases [9, 10]. However, it is thought that the reduction of the respiratory volumes and the spirometric indicators of lung function have also a significant contribution to the reduced cardiorespiratory fitness in respiratory diseases, especially asthma. Some studies have not observed a relationship between spirometric indicators and cardiorespiratory fitness in the patients [7, 11]. Considering the conflicting evidence, the present study aimed at determining the relationship between the cardiorespiratory fitness with some respiratory parameters indicative of pulmonary function in a group of men with chronic asthma.

METHOD AND SUBJECTS

Based mentioned above, in present study, we aimed to determine the relationship between VO_2max as cardiorespiratory fitness determinant and indicator markers of respiratory function in asthma patients. To achieve this outcome, a totally 28 sedentary adult men with asthma participated in this study by accessible samples.

All participants gave their informed written consent before participation in accordance with the ethical guidelines set by Islamic Azad University. The diagnosis of asthma and respiratory function was made by spirometry test. We used three parameters to assess cardiorespiratory functions: FEV1, FVC and FEV1/FVC%. Subjects were asked to refrain from tea, coffee, chocolates and caffeinated soft-drinks on 4 hours before 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.

Inclusion criteria and Anthropometry: A detailed history and physical examination of each subject was carried out. Inclusion criteria for study group were determined as existing asthma for at least three years. The subject did not previously exercise or had any previous participation in weight loss programs (at least during the last three months), or had history of cardiovascular diseases, diabetes or any other medical problem.

Standing height of the barefoot subjects was measured to the nearest 0.1 cm with the use of a wall-mounted stadiometer. Weight was measured to the nearest 100 g using digital scales. Percent body fat was determined using body composition monitor (OMRON, Finland). Body mass index (BMI) was calculated by dividing body mass (kg) by height in meters squared (m^2).

Cardiorespiratory Fitness: Cardiorespiratory fitness was assessed as VO_2max (mL kg^{-1} min^{-1}) was measured using a bicycle ergometer in a stepwise fashion according to YMCA instrucment. This protocol was performed in 5 continues stage without rest between stages. Each stage lasted 3 minute [12].

Data analysis: All data were tested for normal distribution by the Kolmogorov-Smirnov test. Data were analyzed by computer using the Statistical Package for Social Sciences (SPSS) for Windows, version 15.0. The association between VO_2max and spirometric parameters were assessed using Pearson's correlation coefficient. A P-value of < 0.05 was considered to be statistically significant.

RESULTS

Relationship of VO_2max as a determinant of cardiorespiratory fitness in asthma patients was determined in this study. Anthropometric and physiological characteristics of the study participants are described in Table 1. All values are reported as mean and standard deviation.

able 1: Descriptive Statistics of anthropometrical, physiological and spirometrical markers

	N	Minimum	Maximum	Mean	Std. Deviation
Age (year)	28	32	49	38.89	3.337
Height (cm)	28	170	177	174.54	1.990
Weight (kg)	28	75	109	92.64	9.673
Abdominal (cm)	28	88	118	101.93	8.919
Hip (cm)	28	86	115	100.96	8.140
BMI (kg/m2)	28	24.49	34.87	30.4043	3.06199
Body fat (%)	28	23.6	33.6	29.736	2.8800
VO2max (mL/;g/min)	28	27	53	35.64	6.843
Forced vital capacity	28	70	100	86.89	9.036
Forced expiratory volume in 1 s	28	58	87	77.61	7.642
FEV1 / FVC	28	63	72	68.68	2.310

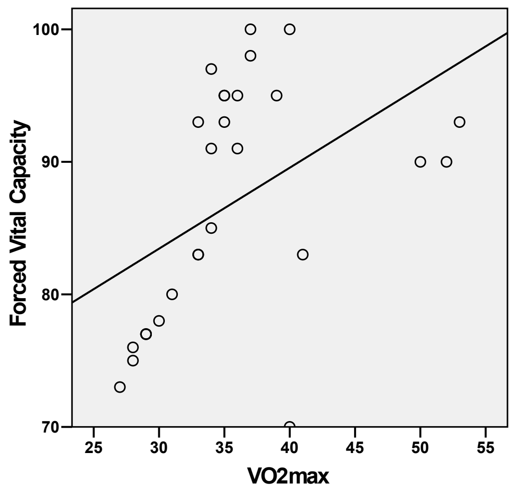
Based on statistical output, we observed that VO_2max was positively correlated with FVC ($p = 0.013$, $r = 0.42$, Fig. 1), FEV1 ($p = 0.005$, $r = 0.52$, Fig. 2) and FEV1/FVC ($p = 0.003$, $r = 0.54$, Fig. 3). Data of relation of VO_2max with Spirometrical markers are showed in Table 2.

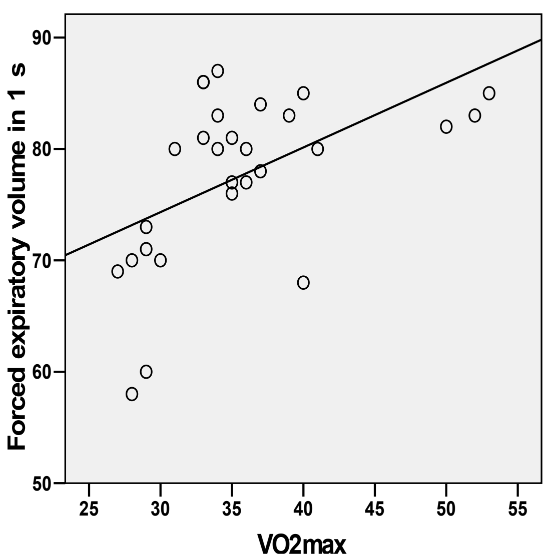
Table 2: Correlations of VO_2max with FVC, FEV1 and FEV1/FVC in studied patient.

		VO2max	FVC	FEV1	FVCFEV1
VO2max	Pearson Correlation	1	.462*	.520**	.543**
	Sig. (2-tailed)		.013	.005	.003
	N	28	28	28	28
FVC	Pearson Correlation	.462*	1	.652**	.765**
	Sig. (2-tailed)	.013		.000	.000
	N	28	28	28	28
FEV1	Pearson Correlation	.520**	.652**	1	.844**
	Sig. (2-tailed)	.005	.000		.000
	N	28	28	28	28
FVCFEV1	Pearson Correlation	.543**	.765**	.844**	1
	Sig. (2-tailed)	.003	.000	.000	
	N	28	28	28	28

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).





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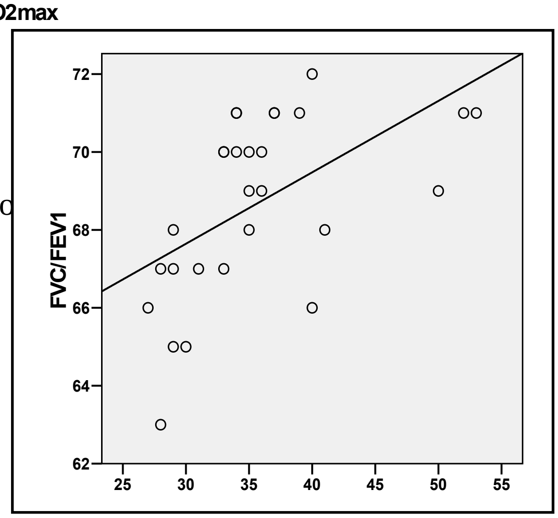

Fig. 2. Relationship of VO_2max with FEV1 in studied patients.

Fig. 3. Relationship of VO_2max with FEV1/FVC in studied patients.

DISCUSSION

A direct significant relationship was observed between cardiorespiratory fitness and each spirometric indicator in asthmatic men. In other words, in the studied asthmatic patients, increase in each of the spirometric indicators, such as FVC, FEV1, and FEV1/FVC, was associated with increased VO_2max levels, as a psychological indicator of cardiorespiratory fitness. These findings indicated that the static markers of lung function directly affected the aerobic capacity in asthmatic patients. It has been reported previously by the majority of studies that the level of cardiorespiratory fitness was reduced in the presence of asthma and other respiratory diseases [7]. On the other hand, lower levels of spirometric indicators, as the determinants of lung function, have been frequently observed in these patients [5]. However, few studies have also pointed to the lack of difference between asthmatic patients and healthy individuals [13].

Today, it is known that exercise not only improves respiratory symptoms of the asthmatic patients, but also increases their physical fitness. [14, 15]. Increased respiratory function due to aerobic exercises in other populations, including adults obese men, has already been reported by some researchers [16]. These training programs enhance the mechanical efficiency of the respiratory muscles, and thereby, improve respiratory indicators [17]. However, changes in pulmonary spirometric indicators are different among different studies. Some studies have indicated that upper and lower exercises significantly improve FEV1 in patients with mild to moderate asthma [18, 19]. But in some other studies, improvements in aerobic fitness and reduced breathlessness was not associated with changes in FEV1 [20]. However, in a recent study, 10 weeks of aerobic exercise did not lead to a change in spirometric indicators in patients with asthma, and a combination of aerobic exercise and resistance training was associated with improvements [21]. Some studies have also shown that aerobic exercise combined with breathing exercises improved lung ventilation, respiratory muscle strength, and muscle coordination, especially the inspiratory muscle, and corrected the breathing patterns. This was shown to be associated with reduced bronchospasm and respiratory tracts obstruction, and consequently relieved dyspnea, which is a common symptom of asthma [22].

In addition to the therapeutic use of exercise in respiratory diseases, such as asthma, some researchers have emphasized on supplement consumption as a therapeutic method. For example, a study showed that the consumption of vitamin D leads to a reduction in respiratory infections, prevention of asthma attacks, and resistance to steroids, reduced osteoporosis, and control of asthma associated with increased IL-10 [23].

In another study, vitamin D consumption along with exercise led to a significant increase in peak expiratory flow and maximal voluntary ventilation and 75% forced expiratory flow in the experimental group compared to the control group [6].

The reduced cardiorespiratory fitness in patients cannot be attributed only to physiological limitations caused by asthma, and sedentary life style and not participating in regular training programs, especially aerobic exercises, also contributes to the lower levels of VO_2max in these patients compared to the healthy controls. Some clinical studies have also suggested the presence of chronic inflammation in the pathogenesis of chronic diseases [24]. They also have supported the role of inflammation in cardiorespiratory fitness levels. They have indicated the relationship between VO_2max, as an indicator of cardiorespiratory fitness, with some inflammatory cytokines, such as IL-1ß, IL-6 and TNF-α [10]. These findings somehow support the effect of inflammatory cytokines on cardiorespiratory fitness in chronic diseases.

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