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# Aerobic capacity and Antioxidant profile in asthma patients

***Alireza Rahimi, Mehdi Kasbparast Jr and Alireza Shokrgozar***
*Department of Sport Injury and Biomechanics,*
*Faculty of Physical Education and Sport Sciences, Karaj Branch,*
*Islamic Azad University, Alborz, IRAN*

*(Corresponding author: Alireza Rahimi)*
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**ABSTRACT: Although there is evidence of systemic inflammation or reduced antioxidant capacity in asthma or other respiratory disease, the pathophysiological mechanisms that link cardiorespiratory fitness with immune system are not fully understood. This study aimed to determine relationship between total antioxidant capacity (TAC) with cardiorespiratory fitness in asthma patients. For this purpose, twenty six adult men with mild to moderate asthma aged 39 ± 2 year were recruited for participate in study and underwent fasting blood samples to measure TAC. Cardiorespiratory fitness (measured as oxygen consumption per unit of time ($VO_2$max)) was determined using results of a graded cycle ergometer exercise. Pearson correlation coefficient test was chosen for evaluating the correlation between TAC and $VO_2$max. A p value less than 0.05 was considered statistically signigcant.**

**Keywords:** Respiratory Function, Aerobic capacity, Asthma

## INTRODUCTION

Several hormonal and metabolic factors are involved in the development of asthma such that understanding the interaction between these factors and their change patterns in weight loss workouts has triggered many of today's research to develop a suitable strategy for the improvement of devastating symptoms of it. In addition to the reduction of cardiorespiratory fitness and lower aerobic fitness, the relationship between asthma with systemic inflammation and function of the immune system, especially against oxidants and free radicals, has been frequently reported [1, 2]. The chronic obstructive pulmonary (COPD) and asthma are defined as chronic inflammatory diseases of the respiratory pathways. There is evidence showing that the systematic inflammation is involved in their pathogens [3]. Scientific literatures indicate lower cardiorespiratory in such patients [4]. On the other hand, the role of oxidative stress has been suggested in the pathogens of some chronic inflammatory diseases as asthma, such that those references add up to the reduction of total antioxidant capacity in the patients with asthma [5]. The relationship between these reactive oxygen species (ROS) and several pathophysiological changes in asthma indicates their vital role in the development and severity of this disease, which is associated with increased lipid peroxidation, sensitivity and secretions in the respiratory pathways in such patients [6].

In addition, the lack of antioxidants in the respiratory pathways of these patients is connected with intensified symptoms, reduced respiratory performance, and increased inflammation [7].

For example, in a recent study, a significant relationship between the intensity of asthma with total antioxidant capacity and other oxidants such as superoxide dismutase, catalase, and plasma has been observed [8]. Since in addition to the inflammation of respiratory pathways, the majority of patients with asthma have an inactive life style and are less involved in sport activities, due to the incidence of asthma attack, they have lower cardiorespiratory and aerobic capacity [4]. In this regard, there are studies that have reported lower levels of total antioxidants capacity in such patients, relative to healthy people [2, 9].

Furthermore, although inflammation, or resistance of respiratory paths, affects their aerobic fitness, it seems that other environmental factors are also influential. Scientific literature has reported lower levels of both total antioxidant capacity and cardiorespiratory fitness in the patients with asthma; yet, there are limited numbers of research on the relationship between them in those patients. Therefore, the present study aims for investigating the relationship between cardiorespiratory fitness and aerobic capacity with the total antioxidant capacity in a group of male patients with chronic asthma.

## METHOD AND SUBJECTS

To analyze whether antioxidant capacity is associated with cardiorespiratory fitness in asthma patients, twenty six sedentary adult men aged 39 ± 2 year, body mass index (BMI) 31 ± 3.6 kg/m2 with mild to moderate intensity of asthma comprised the sample. Measurements included total antioxidant capacity and $VO_2$max as a good indicator of cardiorespiratory fitness.

The diagnosis of asthma and its severity was made by spirometry test. Written informed consent was obtained from all participants. Subjects were asked to complete questionnaires on anthropometric characteristics; general health, smoking, alcohol consumption, and present medications. Asthma diagnosis at least for 3 years was main inclusion criteria. Participants were non-athletes, non-smokers and non-alcoholics. All subjects were non-smokers and had not participated in regular exercise/diet programs for the preceding 6 months. Potential participants were excluded from the study if they reported smoking or had a history of heart disease, arthritis, stroke, diabetes, hypertension, cancer, heart attack or chronic cough.

Each subject's anthropometrical markers were measured. Body mass index (BMI) was calculated by dividing body mass (kg) by height in meters squared ($m^2$). Weight was measured to the nearest 100 g using digital scales. Standing height was measured to the nearest 0.1 cm with the use of a wall-mounted stadiometer. Waist circumference and hip circumference were measured in the most condensed part using a non-elastic cloth meter. Following 5 minutes sitting rest in the lab, their pulmonary functions were assessed by computerized spirometer (Minispire, Italy)

To measure TAC, blood samples were collected of all subjects that attend in hematology lab between between 8:00–9:00 a.m. after an overnight fasting for all subjects. All participants refrained from any severe physical activity 48 h before blood sampling.

TAC was determined by FRAP method (the sensitivity of method was 0.1 Units/ml). For determine Cardiorespiratory fitness (measured as oxygen consumption per unit of time ($VO_2$max)), all subgects were completed a graded cycle ergometer exercise. Cycling test included 5 continues stage without rest between stages and each stage lasted 3 minute. In each stage, intensity was increased according to protocol guideline (10).

**Statistical analyses:** Statistic analysis was done with SPSS 16.0 for Windows. Normal distribution of data was analyzed by the Kolmogorov-Smirnov normality test. Pearson correlation coefficients were used to determine the associations between VO2max with total antioxidant capacity. Significance was accepted at $P < 0.05$.

## RESULTS AND DISCUSSION

In this study we determined relationship in total antioxidant capacity with cardiovascular fitness or aerobic capacity in males with chronic asthma. Table 1 shows the descriptive anthropometric features of studied subjects. These data indicate that the subjects are obese or overweight.

Total antioxidant capacity, $VO_2$max and Spirometrical markers are showed in Table 2 a significant positive correlation was observed between total antioxidant capacity and aerobic capacity ($p = 0.008$ , $r = 0.51$, Fig. 1). Although there is not any research that has directly investigated the relationship between the total antioxidant capacity and cardiorespiratory fitness in the patients with asthma, findings of the present study maintains a direct correlation between them. In other words, the changes pattern of the total antioxidant capacity, as a specific immune system against free radicals or oxidants, is connected to $VO_2$max, as a salient indicator of the cardiorespiratory fitness.

**Table 1: Mean and standard deviation of anthropometric characteristics in studied subjects.**

| Variables | Mean | Standard deviation |
|---|---|---|
| **Age** (year) | 38.7 | 2.02 |
| **Weight** (kg) | 92.1 | 7.7 |
| **Height** (cm) | 172 | 7.7 |
| **Body mass index** ($kg/m^2$) | 31.17 | 3.56 |
| **Abdominal circumference** (cm) | 102 | 8.2 |
| Hip circumference (cm) | 100 | 6.6 |
| **Systolic blood pressure** (mmHg) | 124 | 8.6 |
| **Diastolic blood pressure** (mmHg) | 87 | 5.9 |

**Table 2:** Mean and standard deviation of clinical and Spirometrical characteristics of studied subjects.

| **Forced vital capacity** (%) | **86** | **8.7** |
|---|---|---|
| **Forced expiratory volume in 1 s** (%) | 77 | 6.8 |
| **FEV1/FVC** | 69 | 2.8 |
| **Forced expiratory flow** (25-75%) | 60 | 14 |
| **Forced expiratory flow** (75%) | 55 | 13 |
| **$VO_2$max** (mL/kg/min) | 36 | 6 |
| **Total antioxidant capacity** (Units/ml) | 0.397 | 0.08 |

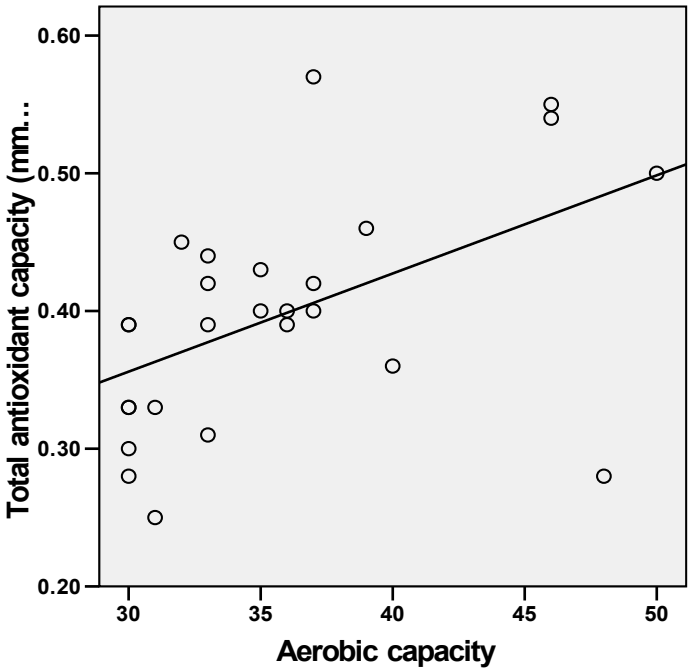


**Fig 1:** Total antioxidant capacity in relation to aerobic capacity in studied patients: A significant positive correlation.

In that, decrease in any of them is associated with reduction in the other. Free radicals are molecules with one or more paired electron which can be generated by the majority of body cells, and increased level of them is associated with several damages to the body tissues including damage to plasma membrane and DNA, decreased immune function, joint problems, cardiovascular diseases and mental problems, as the most important ones [11, 12].

Asthma is a disease with inflammatory nature, in which the role of oxidative stress is always indicated in systematic and local forms in the disease's pathogens. In that, the lack of balance between oxidants and antioxidants has a significant role in the prevalence, intensity, or control of this disease [8]. The importance of balance between the oxidants and antioxidants in the creation and control of the disease's symptoms has been reported in some previous studies [8].

There are various factors involved in the prevalence and/or severity of asthma, each with its own specific significance. Impaired secretion of inflammatory cytokine, i.e. increased level of it, and the reduction of anti-inflammatory cytokine are the most important hormonal symptoms of this disease. In addition, increased and decreased levels of anti-oxidants have recently been taken into consideration by the health science researchers [13].

The importance of balance between oxidants and antioxidants in the creation and control of asthma symptoms has been investigated in different studies; in addition, the majority of researchers have reported the particular role the lack of balance plays between them or the presence of oxidative stress in the incidence of pulmonary problems such as asthma [14]. In fact, decreased level of antioxidants in the respiratory pathways in this disease causes intensification of the problem, higher level of oxidants, and increased inflammatory responses [7].

Regarding the inflammatory nature of asthma, the role of oxidative stress is indicated in systematic and local forms in the disease's pathogens. During persistent asthma and asthmatic attack, the capacity of antioxidant serums significantly decreases [5]. Decreased capacity of total antioxidants in smokers, who have lower cardiorespiratory fitness, has also been reported [15]. Although, based on the findings of this study the presence of a causal relationship between them cannot be emphasized, it seems that in addition to other interfering factors, the reduction of total antioxidants capacity in these patients relates to the lower levels of cardiorespiratory fitness of them. Although, investigations into some other healthy population or patients have evaluated a direct relationship between them, some evidence indicates a correlation between antioxidants and inflammatory markers. For example, in a study a significant relationship between the glutathione levels and C-reactive protein, as a proinflammatory cytokine, has been observed in hemodialysis patients [16].

On the other hand, the relationship between VO2max and these inflammatory markers has frequently been reported. For example, in another study on the patients with heart failure, a significant relationship was observed between the changes in VO2max and changes in some inflammatory cytokines such as IL-6, IL-1B, and TNF-a, following a long-term workout plan [17]. The relationship between these two variables (namely the total antioxidant capacity and VO2max) and inflammatory markers mentioned in other studies supports a connection between them in the patients with asthma, as a kind of inflammatory disease. On the other hand, participation in workout plans, especially aerobic exercises, is associated with increased cardiorespiratory fitness [18, 19]. In this regard, studied also have revealed that regular workout plans are associated with increased total antioxidant capacity and other antioxidants in different populations [20]. In another study, a 5-week workout plan improved VO2max and antioxidant profile in young men [21]. These findings indicate that both VO2max and total antioxidant capacity increase in response to regular sport activities. These findings also maintain a direct relationship between them and alignment of their changes in response to exercise.

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