The Effect of Aerobic Physical Exercise on immune system and HS-CRP in male athlete and Non-athletes

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ABSTRACT

The purpose of the present study was to compare the effect of one session of aerobic exercise on white blood cells species leukocytes, lymphocytes, monocyte, neutrophils, basophile and eosinophil. The subjects were 15 male athlete and 15 male non-athlete volunteer men who took part in Bruce standard test voluntarily. Blood samples were collected before and immediately after the exercise. Data analysis was done by dependent and independent t-test. Findings showed that the progressive aerobic exercise caused significant increase in leukocytes (p=0.014), lymphocytes (p=0.492), monocyte (p=0.020), neutrophiles (p=0.0001), basophile (p=0.001) and eosinophil (p=0.182) in athletes but showed no significant alteration in HS-CRP (p=0.465). The progressive aerobic exercise caused significant increase in leukocytes (p=0.001), lymphocytes (p=0.003), monocyte (p=0.036), neutrophiles, basophile (p=0.002), eosinophil (p=0.029) in non-athlete group. The comparison of one session aerobic exercise between athletes and non-athletes showed significant in leukocytes (p=0.0001), lymphocytes (p=0.022), neutrophiles, basophile (p=0.005) and HS-CRP (p=0.0001) but was not significant in monocyte (p=0.675), eosinophil (p=0.871).

Key words:

Introduction

The intensity, duration and frequency of the exercise act as a key role in the determination of the immunological answers and can increase or reduce immune function [1,2]. Physical exercise provides a challenge to homeostasis throughout the body. The immune system, like many other physiological systems, displays substantial perturbations in response to a single bout of exercise. Many studies have documented a stereotypical immune response to vigorous exercise, consisting of a biphasic alteration in circulating immune cell numbers [3,4], reduced natural killer (NK) cell activity [3], reduced mitogen-induced lymphocyte proliferation [5], a reduced salivary immunoglobulin (Ig) secretion [6], and elevated circulating cytokines [7]. These changes in immune function are typically interpreted as being immunosuppressive, an interpretation that is bolstered by epidemiological studies of athletes versus sedentary controls. Two major mechanisms appear to drive the immune response to exercise: neuroendocrine factors and muscle damage. Regular exercise has been reported to have several favorable effects on physiological, psychological, and immunological functions [17,31], and increase in the resistance against infections [29,31,21]. Vigorous exercise, however, has been reported to have a negative effect on these functions [31,16]. On the other hand, training of high volume and intensity accomplished by athletes have been related to increases in the IRS susceptibility [8]. Intense trainings still can reduce the lymphocytes function of to accelerate the apoptosis process in these cells [9].

Short-term high-intensity repeated exercise (intense training) is necessary for athletes. However, high-intensity exercise induces lymphocytopenia [10,11]. Indeed, previous studies reported that basal lymphocytes are lower in athletes [12,13]. Increased risk of developing upper respiratory tract infection (URTI) following intensive training or competitions schedules has been reported in athletes [14]. Several studies have established that high intensity aerobic exercise causes a unique, biphasic perturbation in the circulating leukocyte count [15]. Immediately post exercise, total leukocytes, represented evenly by neutrophils and lymphocytes, with a small contribution of monocytes, increase 50-100% above resting pre-exercise values. Within 30 min of recovery, the lymphocyte count dips 30-50% below pre-exercise levels, remaining low for 2-6 h. Eosinophils also egress from circulation, while basophils remain largely unaffected. As this occurs, circulating
neutrophils increase markedly and are maintained for a prolonged period. Moderate intensity exercise (<60% VO2max) has repeatedly demonstrated a much smaller degree of post-exercise leukocytosis, lymphocytosis, and neutrophilia, and a less-pronounced lymphocytopenia during recovery when compared to higher intensity activity [16]. Reducing discrepancies in findings the purpose of present study was evaluating influence of aerobic physical exercise on some indices of immune system and Hs-CRP in athletes and non-athletes.

**Materials and Methods**

The research was semi-experimental. Thirty healthy male athletes and non athletes (age 23.20±1.04-22.50±97) voluntarily participated in the study. All subjects completed a medical questionnaire to ensure that they were not taking any medication, and were free from cardiac, respiratory and renal diseases. The age, height, weight, bodyfat percentage of all subjects were recorded. The subjects were divided into two groups of athlete (15 members) and non-athlete (15 members). The aerobic exercise program included Bruce test. Warm up and cool down were performed 10 minutes.

**Blood samples and biochemical markers:**

To examine the biochemical variables, blood samples were gathered after 12 to 14 hours of fasting. First, the subjects were required not to perform any physical activity two days before the test. 5 cc of blood was obtained from each subject’s left-hand vein in sitting and resting statuses. Then, the athlete and non-athlete groups performed Bruce test. After the exercise, the blood samples were obtained from the two groups like the first stage. Clauss method was used to measure immune cell (leucocyte, lymphocyte, monocyte, neutrophil, basophile, eosinophil, and an especial kit with Elisa method to measure CRP.

**Statistical methods:**

Descriptive statistics and independent t-test was used for analysis of data distribution and to draw tables and for deductive statistics. All statistical operations were done by SPSS/17 at α ≤ 0.05.

**Result:**

The demographic properties of the athlete and non-athlete groups are presented in Table 1. Results are shown at Table 2. Intergroup comparisons leukocytes (p=0.014) were significantly increased in the group of athletes. Intergroup comparisons leukocytes (p=0.001) were significantly increased in the group of non-athletes.

Between group comparisons lymphocytes (p=0.0001) were significantly increased in the group of athletes and non-athletes. Intergroup comparisons lymphocytes (p=0.042) were significantly increased in the group of athletes. Intergroup comparisons lymphocytes (p=0.003) were significantly increased in the group of non-athletes. Between group comparisons lymphocytes (p=0.022) were significantly increased in the groups of athletes and non-athletes.

Intergroup comparisons monocyte were (p=0.020) significantly increased in the group of athletes. Intergroup comparisons monocyte (p=0.036) were significantly increased in the group of non-athletes. Between group comparisons monocyte (p=0.675) were no significantly in the groups of athletes and non-athletes. Intergroup comparisons eosinophil (p=0.182) were no significantly increased in the group of athletes. Intergroup comparisons eosinophil (p=0.029) were significantly increased in the group of non-athletes. Between group comparisons eosinophil (p=0.871) were no significantly in the groups of athletes and non-athletes.

Intergroup comparisons basophils (p=0.001) were significantly increased in the group of athletes. Intergroup comparisons basophils (p=0.002) were significantly increased in the group of non-athletes. Between group comparisons basophils (p=0.005) were significantly in the groups of athletes and non-athletes. Intergroup comparisons neutrophils (p=0.0001) were significantly increased in the group of athletes.

Intergroup comparisons neutrophils (p=0.0001) were significantly increased in the group of athletes and non-athletes. Between group comparisons neutrophils (p=0.001) were significantly in the groups of athletes and non-athletes.

Intergroup comparisons HS-CRP (p=0.465) were no significantly increased in the group of athletes. Intergroup comparisons HS-CRP (p=0.011) were significantly increased in the group of non-athletes. Between group comparisons HS-CRP (p=0.0001) were significantly in the groups of athletes and non-athletes.
Table 1: Demographic properties of athlete and non-athlete groups (Mean ± STD).

<table>
<thead>
<tr>
<th>variable</th>
<th>athlete group(n=15)</th>
<th>non-athlete group(n=15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age(year,Mean+SD)</td>
<td>23.20±1.04</td>
<td>22.50±0.97</td>
</tr>
<tr>
<td>Weight(kg,Mean+SD)</td>
<td>177.27±3.22</td>
<td>173.54±4.59</td>
</tr>
<tr>
<td>Height(cm,Mean+SD)</td>
<td>68.19±8.88</td>
<td>68.90±4.59</td>
</tr>
<tr>
<td>Fat(persent,Mean+SD)</td>
<td>11.71±1.78</td>
<td>12.52±1.31</td>
</tr>
<tr>
<td>Body mass index(kg/m,Mean+SD)</td>
<td>21.84±2.87</td>
<td>23.72±2.52</td>
</tr>
</tbody>
</table>

Table 2: Comparison of the Immune cell and CRP Parameters before and after aerobic exercise in athlete and non-athlete groups.

<table>
<thead>
<tr>
<th>Variables</th>
<th>athlete group(n=15)</th>
<th>non-athlete group(n=15)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>White cell pre-test</td>
<td>5885±103</td>
<td>6426±320</td>
<td>0.0001</td>
</tr>
<tr>
<td>post-test</td>
<td>5995±186</td>
<td>6759±230</td>
<td></td>
</tr>
<tr>
<td>Lymphocyte pre-test</td>
<td>1768±149</td>
<td>1748±171</td>
<td>0.022</td>
</tr>
<tr>
<td>post-test</td>
<td>1799±147</td>
<td>1999±173</td>
<td></td>
</tr>
<tr>
<td>Basophile pre-test</td>
<td>32±8</td>
<td>29±5</td>
<td>0.005</td>
</tr>
<tr>
<td>post-test</td>
<td>51±5</td>
<td>38±10</td>
<td></td>
</tr>
<tr>
<td>CRP pre-test</td>
<td>0.55±0.11</td>
<td>0.87±0.30</td>
<td>0.0001</td>
</tr>
<tr>
<td>post-test</td>
<td>0.56±0.10</td>
<td>1.06±0.30</td>
<td></td>
</tr>
</tbody>
</table>

Discussion:

Finding of present study indicated that the progressive aerobic exercise caused significant increase in lymphocyte, monocyte, neutrophile, basophile and eosonophile in athletes but showed no significant alteration in HS-CRP. The progressive aerobic exercise caused significant increase in lymphocyte, monocyte, neutrophile, basophile, eosonophile in non-athlete group. The comparison of one session aerobic exercise between athletes and non-athletes showed significant increase in lymphocyte, monocyte, neutrophile and HS-CRP but was not significant in monocyte, eosonophile. Factors like type, duration, intensity, and program of the exercise and the use of different subjects [20], various complex mechanisms including hormonal, metabolic and psychoneural stress are also known to have effects on the immune system [22, 21]. Following prolonged (>60 min) aerobic exercise at an intensity > 60% VO2max, NK cell activity (NKCA) increases immediately after exercise, but then decreases below resting values for several hours [3, 7] during recovery. Several studies have established that high intensity aerobic exercise causes a unique, biphasic perturbation in the circulating leukocyte count [15]. Immediately postexercise, total leukocytes, represented evenly by neutrophilis and lymphocytes, with a small contribution of monocytes, increase 50-100% above resting pre-exercise values. Within 30 min of recovery, the lymphocyte count dips 30-50% below pre-exercise levels, remaining low for 2-6 h. Eosinophils also egress from circulation, while basophils remain largely unaffected. [16]. Neutrophils and monocytes play an important role in innate or nonspecific immunity. Neutrophils compromise approximately 60% of all circulating leukocytes. They migrate to sites of infection where they bind, engulf, and destroy pathogens via phagocytosis involving both oxidative and nonoxidative means. [23]. Changes in the immune functions due to aerobic exercise and training have been attributed to the increased secretion of cortisol, catecholamine and the neuropeptides [24, 25, 26]. During exercise, when the max O2 consumption exceeds 60% an increase in theepinephrine and cortisol concentrations occurs [27]. Exercise increases the number of lymphocytes in the circulation by acting as a lymphocytic β2-adrenergic agonist. Cortisol on the other hand blocks the entry of lymphocytes which would otherwise lead to strong neutrophilia in the circulation, thereby facilitating the passage of lymphocytes from the lymphoid compartments [28, 29, 30, 26]. Also, research findings have shown that high intensity anaerobic exercise, especially, eccentric exercise can stimulate acute phase response (APS) and hs-CRP. Many researchers have reported that there is a high association between the cardiovascular fitness and the level of CRP [36, 37, 38, 32, 33, 34, 35]. Continuous exercise has beneficial cardiovascular effect on the prevention and treatment of cardiovascular system and causes an increase in protective capacity of cardiovascular system in humans [32, 39, 40].

In conclusion, our finding showed that the progressive aerobic exercise caused significant increase in lymphocyte, monocyte, neutrophile, basophile and eosonophile in athletes but showed no significant alteration in HS-CRP. The progressive aerobic exercise caused significant increase in lymphocyte, monocyte, neutrophile, basophile, eosonophile in non-athlete group. The comparison of one session aerobic exercise between athletes and non-athletes showed significant increase in lymphocyte, monocyte, neutrophile, basophile and HS-CRP but was not significant in monocyte, eosonophile.

References


