THE EFFECT OF EXERCISE ON BLOOD PARAMETERS

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Background: Exercise induces physiological stress on the body and brings the changes in the interior milieu. The aim of present study was to observe changes induced by moderate exercise in haematological parameters of our young healthy population.

Methods: This study was carried out at Department of Physiology, University of Sindh, Jamshoro. Eighty eight (88) students were included. Estimation of haemoglobin, total white blood cells count, differential leucocyte count, erythrocyte sedimentation rate, and blood pressure (BP) were carried out before and after standard exercise (30 minutes jogging).

Results: The mean age of the subjects was 23.32 years. In total sample before exercise the mean systolic and diastolic BP were 118.64 mm Hg and 77.59 mm Hg respectively, ESR was 10.86 mm/l Hr, WBC count 6390.59 /mm³, and Hb was 12.38 g%, while after exercise the mean systolic and diastolic blood pressures were 139.55 mm Hg and 110.91 mm Hg respectively, ESR was 10.86 mm/l Hr, WBC count was 12488.86, and Hb was 12.37 g%. The same parameters for female subjects before and after exercise were mean systolic and diastolic BP, ESR, WBC count and Hb were 118.57 mm Hg, 77.5 mm Hg, 10.79 mm/l Hr, 5994.5/mm³ and 10.96 g% respectively, while after exercise the same were 139.29 mm Hg, 114.29 mm Hg, 10.79 mm/l Hr, 11775.36/mm³ and 10.96 g% respectively. In male subjects before exercise systolic and diastolic blood pressure, ESR, WBC count and Hb were 118.75 mm Hg, 77.75 mm Hg, 9.63 mm/l Hr, 7083.75/mm³ and 14.84 g% respectively. After exercise the same were 140 mm Hg, 105 g% Hb, 9.63 mm/l Hr, 13737.5/mm³ and 14.84 g% respectively.

Conclusions: Exercise stress leads to significant increase in total white blood cell counts in both male and female subjects.

Keywords: Blood cell study, exercise, stress, leukocytosis.

INTRODUCTION

From the historical point of view the leucocytosis following acute bouts of physical work is well known since the end of the past century.¹ In the first three decades of this century plenty of reports dealt with differential blood counts of peripheral blood following various kinds of exercise.² In 1924, A.Egoroff³ showed the reaction of total leucocyte counts, granulocyte, monocyte & lymphocytes to a marathon race outlining a granulocytosis and lymphopenia during the first hours after the end of exercise. In 1932 Edwards and Wood, concluded from their own experiments and literature findings that “lactic acid”, blood sugar, blood pressure, body temperature and capillary dilation can be ruled out as separate variables directly related to leucocytosis in exercise.⁴ In 1953 Rohde and Wachholder were the first to describe that leucocyte count showed a significant increase to almost maximal values with the first minute of exercise.⁵ During the late 70’s there were a number of studies, showing that blood cell concentrations of functionally distinct lymphocyte sub-populations and as identified later the natural-killer cells were altered differently.⁶,⁷

During the 8th decade the interest of immunologists grew and new laboratory methods for the investigation of the acute immune response to exercise were developed. Both growing interest of immunologists and new methods, stimulated by the increasing number of investigations about the acute immune response to exercise. The number of reviews during the past years grew enormously.⁸⁻¹²

The aim of present study was to observe changes induced by moderate exercise in haematological parameters of our young healthy population.

SUBJECTS AND METHODS

The experimental work was carried out at Department of Physiology, University of Sindh, Jamshoro during the academic session 2003-2004. To study this phenomenon the blood parameters of subjects of eighty-eight (88) healthy students both female, (n=56) and male (n=32) of age group between 18–23 years, were examined for haematological investigations before and after exercise. The venous blood was collected and used for all haematological investigations. The sample of blood was collected under aseptic conditions, 1.2 mg of anhydrous salt of EDTA per ml. of blood was used as an anticoagulant.¹³ After jogging of about 30 minutes blood samples were obtained immediately. Haemoglobin (Hb) was estimated by Sahli’s haemometer, using cyanomethaemoglobin method, while improved Neubauer chamber was used for Total Leukocyte Counts (TLC). Blood smears were prepared and blood films stained with Leishman’s stain for Differential Leukocyte Counts (DLC). Compound microscope was used throughout the
study. Erythrocyte Sedimentation Rate (ESR) was observed by Westergren method and blood pressure was measured by auscultatory (indirect method), using sphygmomanometer and stethoscope. Pressure was applied externally to the brachial artery and pressure determined by listening to arterial sounds using stethoscope. Values obtained before exercise were compared with those observed after exercise.

RESULTS

The results of this study for all subjects considered together are summarized in table-1, while table-2 and 3 give separate results for male and female subjects.

Table-1: Effects of exercise on blood parameters of total sample before and after exercise.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Age (Years)</th>
<th>Systolic B.P. (mm)</th>
<th>Diastolic B.P. (mm)</th>
<th>ESR (mm/1st h)</th>
<th>WBC/mm³</th>
<th>Hb (g/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>23.32 ± 0.58</td>
<td>118.64 ± 8.05 (0.313)</td>
<td>77.59 ± 7.19 (0.723)</td>
<td>10.86 ± 6.18 (0.026)</td>
<td>6419 ± 1186 (0.527)</td>
<td>12.38 ± 2.44 (0.162)</td>
</tr>
<tr>
<td>After</td>
<td></td>
<td>139.32 ± 12.5 (0.283)</td>
<td>110.91 ± 14.79 (0.503)</td>
<td>10.86 ± 6.18 (0.026)</td>
<td>12478.6 ± 2915.53 (0.427)</td>
<td>12.38 ± 2.44 (0.162)</td>
</tr>
</tbody>
</table>

(n=88, all values in Mean ± SD, p value in parenthesis)

Table-2: Effects of exercise on blood parameters of males (n=32) before and after exercise.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Age (Years)</th>
<th>Systolic B.P. (mm)</th>
<th>Diastolic B.P. (mm)</th>
<th>ESR (mm/1st h)</th>
<th>WBC/mm³</th>
<th>Hb (g/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>23.27 ± 0.508</td>
<td>118.75 ± 9.84 (0.957)</td>
<td>77.75 ± 7.50 (0.151)</td>
<td>9.625 ± 3.38 (0.265)</td>
<td>7083.75 ± 1366.28 (0.628)</td>
<td>14.84 ± 1.38 (0.373)</td>
</tr>
<tr>
<td>After</td>
<td></td>
<td>140 ± 17.08 (0.539)</td>
<td>105 ± 15.57 (0.119)</td>
<td>9.625 ± 3.38 (0.265)</td>
<td>13737.5 ± 2037.51 (0.294)</td>
<td>14.845 ± 1.38 (0.373)</td>
</tr>
</tbody>
</table>

(n=32, all values in Mean ± SD, p value in parenthesis)

Table-3: Effects of exercise on blood parameters of females (n=56) before and after exercise.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Age (Years)</th>
<th>Systolic B.P. (mm)</th>
<th>Diastolic B.P. (mm)</th>
<th>ESR (mm/1st h)</th>
<th>WBC/mm³</th>
<th>Hb (g/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>23.21 ± 0.49</td>
<td>139.3 ± 13.08 (0.539)</td>
<td>114.28 ± 15.57 (0.119)</td>
<td>10.78 ± 7.43 (0.277)</td>
<td>11775.3 ± 3671.25 (0.394)</td>
<td>10.96 ± 1.63 (0.609)</td>
</tr>
<tr>
<td>After</td>
<td></td>
<td>139.3 ± 13.08 (0.539)</td>
<td>114.28 ± 15.57 (0.119)</td>
<td>10.78 ± 7.43 (0.277)</td>
<td>11775.3 ± 3671.25 (0.394)</td>
<td>10.96 ± 1.63 (0.609)</td>
</tr>
</tbody>
</table>

(n=56, all values in Mean ± SD, p value in parenthesis)

DISCUSSION

It is being reported that exercise exerts physiological “stress” on the body and results number of chemical (hormonal) and cellular changes, beside physical change as raised blood pressure, body temperature and oxygen intake. This depends on number of factors as the type and duration of exercise, climate, physical body status, and nutrition etc. Exercise also induces immune like response, results leukocytosis that is quantitatively similar to the response against physiological insults to immune system.

The leucocytosis of exercise has been often compared to inflammation like reaction. The exercise induced increase of neutrophils was previously described to be at least partially due to increased cortisol levels in the blood.14-16

In our findings there was 200% increase in WBC from base line plasma circulatory level of 4000 WBC average.

As exercise induced in percentage of reactive leucocytosis is considered to be dependent on various factors, we have found that after strenuous exercise the number of leukocyte become almost double. No change in ESR, and the response is different among the subject as indicated by a large SD. This variability is most probably a result of difference in the physical body status and nutrition. While a very slight increase in Erythrocyte Sedimentation Rate (ESR) may be contributed to the difference in the physical body status and nutrition. SD. This variability is most probably a result of different among the subject as indicated by a large SD. This variability is most probably a result of difference in the physical body status and nutrition.

TABLE 1: Effects of exercise on blood parameters of total sample before and after exercise.

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monocytes are the main source of cytokines belonging into TNF family and of IL-1. Mature monocytes have a lower capacity to produce these cytokines. Regular monocytes and activated macrophages release abroad spectrum of cytokines. And it is the second wave of cytokines release that augmented homeostatic signal and initiates the cellular and cytokines cascades that are involved in the complex process of exercise induced, acute phase reaction (APR). As a result molecules emerge from local tissue site being highly chemotactic for neutrophils, e.g., (IL-8) and mononuclear cells.

Physiological studies have shown that stress from any source can influence on the endocrine, haemopoietic and immune systems. Cytokines and Cortisol seems to play an important role in the communication between these systems. The well-documented changes that occur are increase in erythrocytes, neutrophils and platelets, whereas lymphocytes, eosinophils and monocytes decrease in number.

Our observations suggest that physical stress supports to cure by increasing WBC count and fighting infections hence normalize the homeostasis and minimize dose and duration of medication. Recovering from ill ness can be monitored by the white cell count by the rise and fall indicating the improvement or worsening the condintion.

REFERENCES


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