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 leukocyte 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/1st Hr, WBC count 6390.59 /mm^3, 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/1st 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/1st Hr, 5994.5/mm^3 and 10.96 g% respectively, while after exercise the same were 139.29 mm Hg, 114.29 mm Hg, 10.79 mm/1st Hr, 11775.36/mm^3 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/1st Hr, 7083.75/mm^3 and 14.84 g% respectively. After exercise the same were 140 mm Hg, 105 mm Hg, 9.63 mm/1st Hr, 13737.5/mm^3 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 centry.[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.Egoroff[3] showed the reaction of total leukocyte counts, granulocyte, monocyte & lymphocytes to a marathon race outlining a granulocytosis and lylmphopenia 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 leukocyte 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.

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

(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.

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

(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.

Condition	Age (Years)	Systolic B.P. (mm)	Diastolic B.P. (mm)	ESR (mm/1st h)	WBC/mm3	Hb (g/dl)
Before Exercise	23.21 ± 0.49	118.57± 6.92 0.314	77.5 ± 7.07 0.581	10.78 ± 7.43 0.277	5994.5± 839.80 0.983	10.96 ± 1.63 0.609
After Exercise		139.28 ± 13.08 0.539	114.28 ± 15.57 0.119	10.78 ± 7.43 0.277	11775.36 ± 3671.25 0.394	10.96 ± 1.63 0.609

(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 increased cytokines (inflammation components) as IL–1, IL– 6 and TNF (alpha) and release of acute phase proteins in the liver cells.[17,18]

The exercise induced leucocytosis has been often compared to an inflammation like reaction.[19, 20] Leukocyte count of 12,000–20,000 per cubic mm during infections are not unusual and it is comparable to our mean WBC counts which raised up to 15,550 after exercise. The argument that exercise induced an inflammation like response is also supported by the fact that the raised level of cytokine results increase secretion of adernocorticotrophic hormone (ACTH), which induced the enhancement of systemic cortical levels. It suggests that all the mediators and hormones of this regulatory circle are known to increase by the exercise. Principally monocytes and thrombocytes are responsible for the initiation of exercise induced acute phase reaction. Regular

monocytes are the main source of cytokines belonging into TNF family and of IL–1.[21-23] 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.[24]

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

1. Schultz G. Experimentelle Untersucliungen uber das vorkommen and die diagnostische Bedeutune leukocytose. Deutsch Arch fklin Med 1893;51:234-81.
2. Gabriel H, Kindermann W. The acute immune response to exercise: what does it mean? Int J Sports Med 1997;18(suppl. 1):S28-S45
3. Egoroff A. Die. Verllnderungen des Blubildes wahrend Muskelarbeit bei Gesunden. Z Klin Med 1924;100: 485-974.
4. Edwards HT, Wood WB. A study of leukocytosis in exercise. Arbeit Physiologie 1932;6:73-82.
5. Rohde CP, Wachholder K. Weibes Blutbid und Muskelarbeit. Arbeits Physilogie 1953;15:165-174.
6. Hedfors E. Lymphocyte mobilisation in response to physical work in Sacoidosis Influence on lymphocyte subpopulation. DNA synthesis and cytoxicity. Scand J Respir Dis 1976;57: 151-9.
7. Iioimcx HE, Lvansen M, Wahren J. Physiological variation of blood lymphocyte reactivity: T-cellsubsets, immunolglobulin production and mixed lymphocyte reactivity. Clin Jmmunol Immunophol 1983;27:9-14.
8. Cannon JG, Orencoles SF, Fielding RA, Meydani M, Meydani SN, Faitorone MA, et al. Acute Phase response in exercise :Interaction of age and vitamin E on neutrophils and muscle enzyme release. Am J Physiol 1990;259:1214-9.
9. Cannon JG. Exercise and resistance to infection. J Appl Physiol 1993;74:973-81.
10. Fielding RA, Manfredi TJ, Ding W, Fiatarone MA, Evans WJ, Cannon JG. Acute phase response in exercise, III, Neutrophil and IL-I beta accumulation in sketal muscle Am J Physiol 1993;265:166-172.
11. Gabriel H, Kindermann W. Infections and sports: Frequency, causes and preventive aspects. Dtsch Z Sport Med (supplement) 1995;46:73-85.
12. Gabriel H, Urhausen A, Kindermann W. Mobilization of circulating leucocyte and lymphocyte subpopulations during and after a short, anaerobic exercise. Eur J Appl Physiol 1992;65:164-70.
13. Dacie JV, Lewis SM. Practical Hematology, 7th ed. 1991. p77.
14. Gabriel H, Schwarz L, Steffens G, Kindermann W. Immunoregulatory hormones, circulating leucocyte and lymphocyte subpopulations before and after endurance exercise of different intensities. Int J Sports Med 1992;13: 359-66.
15. Kearst D, Cameran K, Morton AR. Exercise and immune response. Sports Med 1988;5:248-67.
16. McCarthy DA, Dale MM. The leukocytosis of exercise. A review and model. Sports Med 1988;6:333-6.
17. Baker B, Gaffins L, Weels MT, Brockutne JG. Endotoxins in racehoree following exertion. J S Afr Vet Assoc 1988;59:63-6.
18. Bosemberg AT, Brockutne JG, Gaffin SL, Wells MTB, Blake GTW. Steronous exercise causes systemic endotoxerima. J Appl Physiol 1988;65:106-8.
19. Northoff II, Berg A. Immunologic mediators and parameters of the reaction to strenuous exercise. Int J Sports Med (Supplement 2) 1992;12: S9-S15.
20. Northoff II, WeinStock C, Berg A. The cytokine response to strenuous exercise. Int J Sports Med (supplement 3) 1994;15: S167-171.
21. Bauman H, Gauldie J. The acute phase response. Immunol Today 1994;15:74-80.
22. Woods JA, Davis JM, Kohut ML, Ghaffar A, Mayer EP, Pate RR. Effects of exercise on the immune respose to cancer. Med Sci Sports Exerc 1994;26:1109-15.
23. Ziegler-Heitbrrck HWL, Ulevitch RJ. CD14: cell surface receptor and defferentiation marker. Immunol Today 1993;14:121-5.
24. Matsusthiman K, Oppenheim JJ. Interleukin-8 and MCAF: Novel inflammatory cytokines inducible by ILI and TNF. Cytokine 1989;1:2-13.

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