J Ayub Med Coll Abbottabad 2003;15(1)

EFFFECTS OF INTENSITY AND DURATION OF EXERCISE ON DIFFERENTIAL LEUCOCYTE COUNT

Shaukat Ali, Farman Ullah and Rahat Jan.

Department of Physiology, Gomal Medical College, DI Khan

Background: Increases in neutrophils, lymphocytes and monocytes account for the exercise induced leucocytosis, related to work loads and duration of exercise. To observe the effects of intensity and duration of exercise on differential leucocytes count, two groups of normal healthy male adult subjects were exercised on treadmill for different duration and intensities. **Methods:** Group-I subjects (n=15) performed exercise by running for a duration of 2–3 minutes, at 7% grade (4 degree inclination) and at speed ranging from 7.5 to 9 Km/hour, while group-II subjects (n=15) walked on treadmill for a duration of 7–10 minutes at zero grade and at Speed ranging from 5 to 6 Km/hour. Pricking the tip of finger with a lancet under sterilized conditions at three occasions i.e. before exercise, immediately after and 30 minutes after exercise, a drop of blood was taken. Each drop of blood was put on a neat and clean glass slide to make film for differential leucocytes count. The samples were then analyzed by standard methods and evaluated artistically. **Results:** In group-I subjects, neutrophils were significantly increased by 5.97% immediately after exercise and were significantly decreased by 13.471% after 30 minutes rest and so the neutrophils were 8.454% below baseline (p<.0.001) 30 minutes after exercise. Lymphocytes were significantly increased by 19.57%, 30 minutes after exercise and were 17.734% above baseline (p<0.001) Eosinophils were significantly increased by 38.042% after 30 minutes rest and were 33.333% below baseline (p<0.01). Basophiles were 50.187% less (p<.0.01) 30 minutes after exercise than pre-exercise. In-group II, neutrophils were significantly increased by 4.30%, immediately after exercise and then decreased significantly by 6.019%, after 30 minutes rest. On the other hand, lymphocytes were significantly decreased by 11.981%, immediately after exercise and then increased significantly by 12.379%, after 30 minutes rest. **Conclusions**: It clearly indicates that the exercise of high intensity and less duration has greater effect on neutrophil count. The increase in lymphocyte count, 30 minutes after exercise, clearly indicate that exercise of low intensity and longer duration is helpful in improving acquired immunity.

Key Words: Exercise Intensity, Duration, DLC

INTRODUCTION

Exercise of proper intensity, duration and frequency significantly improves physical working capacity of individuals of all ages[1]. Leucocytes, the mobile units of the body protective system[2], is significantly affected by exercise[3]. Increases in neutrophils, lymphocytes and monocytes account for the exercise-induced leucocytosis[4] and are related to work loads[5]. The neutrocytosis following exercise is more dependent on the duration than on the intensity of exercise[6]. As, the change in peripheral leucocyte number is diagnostically informative and may be a prognostic marker, reflecting organ damage and restoration after strenuous physical exercise[7].Therefore,

in the present study, the subjects were exercised for different intensities and durations to observe the effects on differential leucocyte count.

MATERIAL AND METHODS

This study was conducted in the Department of Physiology, Basic Medical Sciences Institute, Jinnah Postgraduate Medical Centre, Karachi. Experiments were performed on 30 volunteers, who were normal healthy male adults with no positive clinical findings. All of them were non-smokers.

Pricking the tip of finger with a lancet under sterilized conditions at three occasions, i.e., before exercise (at complete rest), immediately after and 30 minutes after exercise, a drop of blood was taken. Each drop of blood was put on a neat and clean glass slide to make film. After staining with Leishman's stain, the cells were counted by visual counting using a 3.7 mm oil-immersion lens (×100). The results were recorded in percentage for each type of cell[8] and statistically evaluated.

All of the experiments in this study were performed between 9:00 A.M. and 1:00 P.M., to avoid possible circadian fluctuations of leucocytes in the blood. On the experimental day, a general physical examination was made and the procedure of treadmill exercise was explained to all the study participants' prior to exercise. A continuous monitoring of treadmill belt velocity was observed throughout the test[6]. The selected subjects were divided into two groups and the subjects of each group were exercised on the treadmill, AR-160A (Minato Medical Science Company, Japan). Subjects of group-I (n=15) performed exercise by running for a duration of 2–3 minutes, at 7% grade (4 degree inclination) and at speed ranging from 7.5 to 9 Km/hour. While subjects of group-II (n=15) performed exercise by walking for duration of 7–10 minutes at zero grade and at speed ranging from 5 to 6 Km/hour.

RESULTS

Table-1: Differential leucocyte count group-i treadmill running. Mean ± SEM (n=15)

Cell %	Pre-exercise	Immediately post-exercise	30 minutes post-exercise
N	55.200±1.713	58.40±1.942	50.533±2.326
L	31.20±1.868	30.67±2.074	36.733±1.809
M	10.267±0.573	10.533±0.710	10.333±0.766
E	2.40±0.349	0.687±0.252	1.60±0.306
B	0.267±0.118	0.133±0.091	0.133±0.091

N=Neutrophil, L=Lymphocyte, M=Monocyte, E=Eosinophil, B=Basophiles

Table-2: Mean of differences ± S.E.M., % variation and *p*-value of differential leucocyte count group-I treadmill running. (n=15)
-=Decrease += increase

	Cell	Immediately post-exercise Vs. Pre-exercise	30 minutes post-exercise Vs. Pre-exercise	30 minutes post-exercise Vs Immediately post-exercise
Mean of Differences ± S.E.M	N	3.20±0.526	-4.687±1.688	-7.60±1.621
	L	0.733±1.694	+5.533±1.776	7.867±1.524
	M	0.267±0.867	0.067±0.592	-0.20±0.750
	E	-1.733±0.295	-0.800±0.383	0.930±0.3011
	B	-0.133±0.088	-0.133±0.088	0.00±0.088
%Variation	N	+5.797	-8.454	-13.471
	L	-1.923	+17.734	+19.657
	M	+2.591	+0.643	-1.948
	E	-71.375	-33.333	+38.042
	B	-50.187	-50.187	0
***p*-value**	N	< 0.001	< 0.01	< 0.001
	L	> 0.5	< 0.01	< 0.001
	M	> 0.5	> 0.5	> 0.5
	E	< 0.5	< 0.01	< 0.01
	B	< 0.5	< 0.01	> 0.5

Table-3: Differential leucocyte count group-II treadmill walking. (n=15), Mean ±SEM

Cell (%)	Pre-exercise	Immediately post-exercise	30 minutes post-exercise
N	54.33±2.260	56.67±2.030	53.40±2.060
L	34.47±1.900	30.33±1.750	34.33±1.780
M	9.13±0.650	10.27±1.070	9.67±0.830
E	2.00±0.330	1.80±0.390	2.97±0.430
B	0.07±0.060	0.27±0.110	0.07±0.060

Table-4: Mean of differences ±SEM, % variation and *p*-value of differential leucocyte count group-ii treadmill walking

n=15, -= Decrease, +=Increase

	Cell	Immediately post-exercise Vs Pre-exercise	30 minutes post-exercise Vs Pre-exercise	30 minutes post-exerc Vs Immediately post-exercise
Mean of Differences	N	2.33±0.500	-0.930±1.325	-3.270±1.095
	L	-4.13±0.930	-0.140±1.032	4.267±1.510
	M	1.13±0.980	0.533±0.848	-0.60±0.810

±SEM	E	-0.20±0.370	0.467±0.451	0.670±0.418
	B	0.20±0.140	0.000±0.094	-0.20±0.140
%Variation	N	+4.307	-1.712	-6.019
	L	-11.981	-0.406	+12.379
	M	+12.377	+5.838	-6.572
	E	-10.00	+23.35	+33.50
	B	+285.714	0	-285.714
***p*-value**	N	< 0.001	< 0.5	< 0.01
	L	< 0.001	> 0.5	< 0.01
	M	< 0.5	> 0.5	< 0.5
	E	> 0.5	< 0.5	< 0.5
	B	< 0.5	> 0.5	< 0.5

DISCUSSION

Many workers reported a post-exercise increase in neutrophils[3,4,9-3]. Neutrophilia of greater magnitude after sever exercise, is also reported by Suzuki *et al* (1995, 1996)[15,16]. Post exercise increase in neutrophils is reported to return to baseline after one hour[3] and 30 minutes[10] after exercise.

Suzuki *et al* (1995)[15] also observed peripheral lymphopenia after termination of exercise and the changes persisted for one hour, even after termination of exercise. Glee son et al (1987)[14] also reported that proportion of lymphocytes to granulocytes, decreased after exercise. Mona *et al* and Boas *et al* (1996)[3,4] reported an initial increase in lymphocytes immediately after exercise and then a decrease below baseline in 1–2 hours after exercise. These findings are in contrast to the present study. One possible explanation for it may be that these workers had counted absolute number of lymphocytes while we have counted relative number of lymphocytes in proportion to other white blood cells.

An increase in monocytes, immediately after exercise is also reported by Gabriel and Kindemann (1997)[6], while Moyana *et al* (1996)[4] and Boas *et al* (1996)[3] reported an initial increase and then a decrease to baseline, 1–2 hours after exercise.

Eosinophilia after exercise was also observed by Moyana *et al* (1996)[4] and Hanson and Flaherty (1981)[9], who has also reported an initial increase and then decrease in basophiles after exercise.

CONCLUSION

Exercise of high intensity and less duration has greater effect on neutrophil count. Exercise of less intensity and longer duration is helpful in improving acquired immunity. Furthermore, precautions must be observed while taking blood samples for such routine investigations, like differential leukocytes count. It is suggested that if the patient is exerted, (depending upon the degree of exertion) must be allowed a 30–60 minutes rest, before taking a blood sample.

REFRENCES

1. Old ridge N.B., Guyatt G.H., Fischer M.E and Rimm A.A. Cardiac rehabilitation after myocardial infarction. JAMA 1988; 260:945-950.
2. Guyton A.C. and Hall J.E. Textbook of Medical Physiology, W.B.Saunders, Philadelphia, 10th Edn., 2000; p.392.
3. Boas S.R., Joswiak M.L., Nixon P.A., Kurland G., O'Connor M.J., Bufalino K. *et al.* Effects of anaerobic exercise on the immune system in eight to seventeen year old trained and untrained boys.J. Pediatrics 1996; 129:846-855.
4. Moyna N.M., Acker G.R., Weber KM., Fulton J.R., Goss F.L., Robertson R.S. and Rabin B.S. The effects of incremental sub maximal exercise on circulating leucocytes in physically active and sedentary males and females. Eur. J. Applied Physiol. 1996; 74(3): 211-218.
5. Brown S.F., Cave R. and Gleeson M. Hematological response to repeated isometric exercise in man. J. Physiol. 1990; 420:56P.
6. Gabriel H. and Kinder Mann W. The acute immune response to exercise: What does it mean? Int. J. Sports Med. 1997; 18(Suppl. 1): S28-45.
7. Kayashima S., Ohno H., Fujioka T., Taniguchi N. and Nugata N. Leucocytosis as a marker organ damage induced by chronic strenuous physical exercise. Eur.J.Appl.Physiol.1995;70(5):413-420.
8. Dacie S.J.V. and Lewis S.M. Practical Haematology, Churchill Living stone, Edinburgh, 7th Edn., 1993; pp.67-69, 77-79 and 694-696.
9. Hanson P.G. and Falaherty D.K. Immunological responses to training in conditioned runners. Clic. Sci. 1981; 60:225-228.
10. Iversen P.O., Arvesen B.L. and Benestad H.B. No mandatory role for the spleen in the exercise induced leucocytosis in man. Clin. Sci. 1994; 86:505-510.
11. McCarthy D.A., Grant M., Marbut M., Watling M., Wade A.J., Macdonald I. *et al.* Brief exercise induces an immediate and a delayed leucocytosis. Br. J. Sports Med. 1991; 25(4):191-195.
12. Sato H., Abe T., Kikuchi T., Endo T., Hasegawa H., Suzuki K. *et al.* Changes in the production of reactive oxygen species from neutrophils following a 100 kilometer marathon. Nippon-Eiseigaku-Zasshi 1996; 51(2): 612-616.
13. Shek P.N., Sabiston B.H., Buguet A. and Radomski M.W. Strenuous exercise and immunological changes: A multiple point analysis of leucocytes subsets, CD_4/CD_8 ratio, immunoglobulin production and NK cell response. Int. J. Sports Med. 1995; 16(7):466-474.
14. Gleeson M., Robertson J.D. and Maughan R.J. Influence of exercise on ascorbic acid status in man. Clin. Sci. 1987; 73:501-505.
15. Suzuki K., Naganuma S., Mochizuki M., Shiraishi M., Nakaji S., Sugawara K. *et al.* Differential patterns of the number and proportion of blood leucocytes following endurance exercise of moderate, strenuous and severe conditions. Nippon-Eiseigaku-Zasshi 1995; 50(2): 631-636.
16. Suzuki K., Naganuma S., Totruka M., Suzuki KJ., Mochizuki M., Shiraishi M. *et al.* Effects of exhaustive endurance exercise and its one week daily repetition on neutrophil count and functional status in untrained men. Int. J. Sports Med. 1996; 17(3):205-212.

Address for Communication:

Dr. Shaukat Ali, Assistant Professor, Department of Physiology, Gomal Medical College, Dera Ismail Khan, Pakistan.