

EFFECTS OF INTENSITY AND DURATION OF EXERCISE ON TOTAL LEUKOCYTE COUNT IN NORMAL SUBJECTS

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Background: Leucocytes the mobile units of the protective system of the body, may circulate freely in the blood, adhere to the vascular endothelium in sites where blood flow is relatively slow and then once again re-enter the circulation in a process of continuous exchange. This process of continuous exchange of leucocytes is influenced by proper stimulation such as exercise. This study was done to observe the effects of intensity and duration of exercise on total leucocyte count. **Methods:** Two groups of normal healthy male adult subjects were exercised on treadmill. Group-I performed exercise by running for a duration of 2-3 minutes, at 7% grade (4 degree inclination) and at constant speed ranging from 7.5 to 9 Km/hour while group-II walked on treadmill for a duration of 7-10 minutes at zero grade and at constant speed ranging from 5 to 6 Km/hour. Blood sample was drawn before exercise, immediately after exercise and after 30 minutes of rest after the exercise. Total leucocyte count was then done by improved Neubauer haemocytometer. **Results:** The mean of pre-exercise total leucocyte count of Group-I subjects (n=15) was $9750 \pm 384.47/\mu\text{l}$, while immediately after exercise the mean total leucocyte count increased to $17856.66 \pm 1213.24/\mu\text{l}$ and after 30 minutes rest, it came down to $10396.67 \pm 648.35/\mu\text{l}$. Whereas, the mean of total leucocyte count of group-II subjects (n=15) was $10266.66 \pm 307.60/\mu\text{l}$ pre-exercise, $16336.66 \pm 866.30/\mu\text{l}$ immediately post-exercise and $1162.33 \pm 718.85/\mu\text{l}$ at 30 minutes post-exercise. The total leucocyte count increased significantly immediately after exercise and it significantly decreased after 30 minutes of rest but was still higher than the pre-exercise count in both the groups **Conclusion:** It is clearly reflected by this study that the magnitude of exercise-induced leucocytosis is higher in exercise of more intensity and less duration.

INTRODUCTION

Sedentary individuals of all ages will achieve significant improvements in physical working capacity by performing appropriate type of exercise at the proper intensity, duration and frequency¹. The ability of exercise to alter the immune system of adults has been well documented in the literature². The leucocytes are the mobile units of the protective system of the body³. The well known phenomenon of leucocytosis is induced by exercise⁴. The change in peripheral leucocyte number is assumed to be diagnostically informative and may be a prognostic marker, reflecting organ damage and restoration after strenuous physical exercise⁵. The intensity of leucocytosis is proportional to the intensity of work and duration of exercise⁶, independent of gender and subject fitness level⁷.

MATERIALS AND METHODS

This study was conducted at the Department of Physiology, Basic Medical Sciences Institute, Jinnah Postgraduate Medical Centre, Karachi. Thirty subjects were selected from the students, staff and residents of JPMC, Karachi according to the following criteria:

Normal healthy male adult subjects with no disease or positive clinical findings.

Age ranging from 18 to 45 years.

Weight ranging from 50 to 85 kilograms.

Non-smokers.

All of the experiments in this study were performed between 9:00 A.M. and 1:00 P.M., to avoid possible circadian fluctuations in the blood concentrations of leucocytes. On the experimental day, a general physical examination of each volunteer was made.

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 test⁸.

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), as follows:

Group-I (n=15): The treadmill exercise was performed by running for a duration of 2–3 minutes, at 7% grade (4 degree inclination) and at constant speed ranging from 7.5 to 9 Km/hour.

Group-II (n=15): The treadmill exercise was performed by walking for a duration of 7-10 minutes at zero grade and at constant speed ranging from 5 to 6 Km/hour.

Each subject was allowed a 30 minutes rest period before taking pre-exercise blood sample. After taking the first sample, each subject was asked to do exercise on treadmill (as mentioned above). Second sample of blood was taken immediately after exercise. Then the subject was comfortably seated in a chair to have rest for 30 minutes and finally third sample of blood was taken at 30 minutes post-exercise. Total leucocyte count was determined manually using an improved Neubauer haemocytometer. The results were statistically evaluated.

RESULTS

The pre exercise and post exercise total leucocyte counts of both the groups are given in tables 1 and 3, while tables 2 and 4 show the differences, percent variation and significance of these differences.

Table-1: Total leucocyte count in Group-I (treadmill running)

Pre-exercise (Cells/ μ l)	Immediately post- exercise (Cells/ μ l)	30 minutes post- exercise (Cells/ μ l)
9750 ± 384.477	17856.667 ± 1213.240	10396.670 ± 648.356

Values are expressed as Mean \pm S.E.M. (n = 15)

Table-2: Mean of differences \pm S.E.M, % variation and p value of total leucocyte count in group I (treadmill running)

	Immediately post- exercise Vs pre-exercise	30 minutes post- exercise vs pre-exercise	30 minutes post- exercise vs immediately post- exercise
Mean of Differences \pm SEM	8106.667 ± 1022.642	646.667 ± 14.719	-7460 ± 16.035
%Variation	+83.145	+6.633	-76.513
P-value	< 0.001	< 0.001	< 0.001

(n=15) – = Decrease + =Increase.

DISCUSSION

In our results total leucocyte count was significantly increased, immediately after exercise in both groups ($P < 0.001$) but the increase is more in group-I (83.145%) than in group-II (59.746%) as reported by Kayashima *et al*⁵ and McCarthy *et al*⁶, who observed an increase of 90% and 115%, respectively. The increase in total leucocyte count reported by these researchers was slightly more because the exercise stress was more severe than the present study.

Table-3: Total leucocyte count in Group-II (treadmill walking)

<i>Pre-exercise</i> (Cells/ μ l)	<i>Immediately post- exercise</i> (Cells/ μ l)	30 minutes post- exercise (Cells/ μ l)
10266.667 ± 307.602	16336.667 ± 866.301	11623.33 ± 718.8551

Values are expressed as Mean \pm SEM. (n = 15)

Table-4: Mean of differences \pm S.E.M, % variation and *p* value of total leucocyte count in group II (treadmill walking)

	Immediately post-exercise	30 minutes post-exercise	30 minutes post-exercise
	Vs pre-exercise	vs pre-exercise	vs immediately post-exercise
Mean of differences \pm SEM	6110.00 \pm 746.03	1396.667 \pm 612.635	-4713.33 \pm 634.779
%Variation	+59.746	+13.657	-46.089
P-value	< 0.001	< 0.001	< 0.001

(n = 15) – = Decrease + = Increase.

Gabriel and Kindermann⁹ reported that moderate exercise elicits lower changes in cell concentration than strenuous exercise. The total leucocyte count was then decreased significantly ($P < 0.001$) after 30 minutes rest, by 76.513% in group-I subjects and 46.089% in group-II subjects. In a study done by Iversen *et al*⁸ the total leucocyte count had returned to pre-exercise level after 30 minutes of completion of exercise. In the present study, although, total leucocyte count had significantly decreased after 30 minutes rest but was still 6.633% ($P < 0.001$) and 13.657% ($P < 0.001$) higher than pre-exercise count in group-I and group-II subjects, respectively. Nieman *et al*¹⁰ have reported that exercise-induced leucocytosis was evident even after three hours of recovery while Suzuki *et al*¹¹ observed the persistence of exercise induced leucocytosis for one hour after termination of exercise.

CONCLUSION

By studying the effects of exercise on leucocyte count in two groups of subjects, who were exercised for different durations and intensities. The present study has clearly indicated that the magnitude of exercise-induced leucocytosis depends upon the intensity and duration of exercise (higher in exercise of more intensity and less duration). Precautions must be taken while drawing blood samples for such routine investigations as total leucocyte count. It is suggested that if the patient is exerted, a 30–60 minutes rest, depending upon the degree of exertion, must be allowed before taking the blood sample.

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