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The effect of time of performing a maximal aerobic exercise session on certain blood components in young male athletes

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ABSTRACT

Physical activity can cause various hematological changes. The purpose of the present research was to examine the effect of time of performing a maximal aerobic exercise session on certain blood components in young male athletes. Thus, 20 athletes were randomly selected from the students of Physical Education in the University of Tehran and were divided into a morning group (N=10; 20.8±0.99 years, 67.45±6.29 kg, and 181.4±4.28 cm) and an aft ernoon group (N=10; 21±0.73 years, 67.24±9.44 kg, and 179. 9±8.21 cm).The morning and afternoon groups perform ed the seven-station Bruce protocol from 8 to 10 A.M. and 3 to 5 P.M. respectively. The present research is quasi-experimental with a pretest-posttest design. Blood samples were collected from both groups before and immediately after the exercise. Mean and standard deviation were used for data description, and repeated measures ANOVA and inferential (correlated t-test) statistics were applied for hypothesis testing at the 0.05 significance level. The result suggested significant differences in the levels of hemoglobin, erythrocytes, leukocytes and platelets of the two groups at different stages of blood sampling (P≤0.05).Comparison of the two groups revealed that there is no significant difference between the morning and the afternoon group in the levels of hemoglobin, platelets, erythrocytes, and leukocytes before and immediately after the exercise. Based on the results of the research, it can be argued that a maximal aerobic exercise session in the morning and the afternoon changes the level of hemoglobin, platelets, erythrocytes, and leukocytes, and that the time of exercise has no effect on the amount of change.

Keywords: Blood Components, maximal aerobic exercise, exercise time, young male athletes

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INTRPDUCTION

Recent physiological and hematological changes due to different physical activities have received much attention from researchers and specialists. Since some exercise sessions have higher intensity, especially at in-season tournaments, the circulatory system and hematological variables may undergo changes that in the long run considerably influence performance and the result of the competition [1].

The circadian rhythm regulates the function of body cells and hormones during a 24-hour cycle. The function of cells and the level of hormones gradually change during the day. Researchers have always been interested in examining the effect of circadian rhythm on the activity of living organisms such as amoebae, amphibians, and mammals. One of the organs that are influenced by the circadian rhythm is the hypophysis whose change manifests itself in the life and performance of organisms by releasing melatonin [2]. Filadelfi et al. (1996) examined the effects of the release of melatonin in cold-blooded vertebrates and came to the conclusion that secretion of melatonin from the pineal gland is a function of the circadian rhythm and creates a connection between the organism and its environment [2].It is necessary to pay attention to this essential internal factor -i.e. the circadian rhythm and

its effect on the physiological condition and consequently the physical performance of individuals. Recent findings in the field of temporal biology (understanding the effects of time on physiological variables) show that human body undergoes many changes during the day and it has a specific ability at any specific time [3].

The adaptation following muscular activity is associated with changes in whole blood volume and whole plasma volume. In many of these cases the changes are necessary for improving physical function. Meanwhile, changes in plasma volume affect the concentration of the substances in the blood, thus affecting the metabolites, substrates, and hormones in the blood. Moreover, muscular activity can make changes in the number of blood cells and their specialized distribution in different cells. Studies on leukocytes provide us with information about the activities of the immunity system, while research on erythrocytes demonstrates the expansion or disturbance in blood's oxygen transfer capacity [1].

Other studies have shown that during an intense exercise, many changes occur in different compounds including plasma, erythrocytes, and hematocrit [4, 5, 6, & 7]. Carlson showed in a study that much of the increase in hematocrit is associated with the release of erythrocytes from the spleen, but there are minor changes in interplasmic and intercellular fluids during physical activities and in particular intense exercises that can significantly affect these changes [8]. Also Bahati and colleagues came to the conclusion that the intensity of physical exercise leads to significant increase in the number of leukocytes [9].

Considering the above issues and the literature on the effect of intense exercise at different times of the day on hematological changes in most sports, on performance, and on the final output of athletes, the present research attempts to answer the question whether the time of exercise (morning or afternoon) affects hematological factors and which time is more appropriate for exercise and sport in young athletes.

MATERIALS AND METHODS

Methodology

The present research is quasi-experimental with a pretest-posttest design. The population of the research consists of all the physical education students of the University of Tehran. From this population, 20 athletes were randomly selected and divided into a morning group (N = 10) and an afternoon group (N = 10).

Table 1 –Mean and standard deviation of height, weight, and age of the subjects in the two groups

Groups	Height(cm)	Weight(kg)	Age(year)
	M±SD	M±SD	M±SD
Morning	180.4 ± 4.28	67.45 ± 6.29	20.8 ± 0.99
Evening	179.9 ± 8.21	67.24 ± 9.44	21.0 ± 0.73

The instruments of data collection include a medical scale made in Germany with the ability to measure up to 150 kilograms with an accuracy of 0.1, a 3-meter tape measure, Fortex chronometer with an accuracy of milliseconds made in Germany, Smooth Fitness 9.65 LS Treadmill made in USA, Sysmex automated cell counter for measuring hematological variables, Polar Heart Rate Monitor, and Bruce protocol which is a seven-station test and is designed for maximal aerobic exercise and for measuring aerobic and cardiovascular capacity. The independent variable of the research is a session of maximal aerobic exercise (Bruce protocol) and the dependent variables of the research are certain hematological factors such as: hemoglobin, erythrocytes, leukocytes, and platelets.

An attempt was made in the present research to accurately control the driving factors and variables at various stages of the project including nutrition, temperature, BMI, location, age, gender, any possible diseases, health status and record, sleeping schedule, and the level of activity from 48 hours before the test. The subjects participated in the tests of the research according to the designed program and in the form of a morning and an afternoon group. Using a pretest-posttest design, the researcher administered the protocol and collected the required data. Bruce protocol was used in the research and since the test was conducted in a laboratory, the variables of temperature and location were controlled.

Four days prior to the test, the necessary explanations regarding sleep and nutrition before the test were provided to the subjects. They were recommended not to have any intense physical activity from 48 hours before the test. The time of testing the morning group and the afternoon group was determined to be 10 A.M. and 3 P.M. respectively. Maximal aerobic exercise was performed on a treadmill and according to Bruce protocol which is designed for measuring aerobic and cardiovascular capacity. The subjects continued the protocol until they were exhausted. 3 milliliters of blood was collected from the subjects by a specialist before, immediately after, and 2 hours after the test.

Descriptive and inferential statistics were used for data analysis. First, Kolmogorov-Smirnov test and Levine's test were applied to ensure the normal distribution of the raw data and the homogeneity of variances of each group. Mean and standard deviation were used for data description and repeated measures ANOVA as well as Bonferroni test were applied for hypothesis testing at the 0.05 significance level.

Findings

According to table 2, during a session of maximal aerobic exercise in the morning and the afternoon, the level of hemoglobin, leukocytes, erythrocytes, and platelets increased in the posttest in comparison with the pretest in both groups. Considering table 2, P-values are 0.000 which is less than 0.05, indicating that there is a significant relationship between the compared means.

Table 2 – The t-test results of of HGB, RBC, PLT and WBC in morning and evening groups

Variable	Test	Morning Group	t	Sig	Evening Group	t	Sig
HGB (g/dL)	Pretest	14.30 ± 0.80	4.76	0.001 *	14.31 ± 0.71	9.69	0.000 *
	Posttest	14.97 ± 0.85			14.95 ± 0.69		
RBC (10^3/Lμ)	Pretest	5223 ± 375.33	5.49	0.000 *	5180 ± 272.61	9.79	0.000 *
	Posttest	5468 ± 416.75			5407 ± 280.57		
PLT (μL)	Pretest	199400 ± 23931	9.97	0.000 *	207272 ± 28855	5.54	0.010 *
	Posttest	241500 ± 26133			244363 ± 41403		
WBC (μL)	Pretest	6620 ± 1759	13.17	0.000 *	7745 ± 1591	9.29	0.000 *
	Posttest	11750 ± 2505			115527 ± 2190		

** denotes significance at P≤ 0.05 level*

Table 3 compares the morning and the afternoon group. The results show that there is no significant difference between the two groups in the level of hemoglobin, platelets, erythrocytes, and leukocytes before and following after a session of maximal aerobic exercise. ($P \geq 0.05$).

Table 3 – The analysis of variance ANOVA results two groups of morning and evening

Variable	Test	Mean	Source	F	Sig
HGB (g/dL)	Pretest	14.30	Between- Subject	0.001	0.978
	Posttest	14.96	Within-Group		
RBC (10^3/Lμ)	Pretest	5200476	Between -Subject	0.092	0.766
	Posttest	5436190	Within-Group		
PLT (μL)	Pretest	203523	Between -Subject	0.458	0.507
	Posttest	243000	Within-Group		
WBC (μL)	Pretest	7209	Between -Subject	2.37	0.140
	Posttest	11633	Within-Group		

RESULTS AND DISCUSSION

The purpose of the present research was to examine the effect of time of performing a maximal aerobic exercise session on certain blood Components in young male athletes. The results suggested a significant relationship in the levels of hemoglobin and erythrocyte of the morning and the afternoon groups at different stages of sampling. The results of the present research are consistent with the findings of Joksimovic et al. (2009) who studied the hematological profiles of Serbian youth national soccer teams. In this study, the findings indicated that young soccer players experienced a significant increase in the number of leukocytes. Moreover, they had significant increases in hematocrit and the number platelets in comparison to their non-athlete peers, and while their hemoglobin concentration only insignificantly increased [10]. Furthermore, the results of the present research are consistent with the findings of Yalcin et al. (2002), Ahmadizad et al. (2005), Craig et al. (2008), Silva et al. (2008), and Hu et al. (2008) [11, 12, 13, 14, & 15]. However, the results were inconsistent with the studies of Huey-June et al. (2004), Karakoc et al. (2005), Fujistuka et al. (2005), and Bobeuf et al. (2009). The reason for such inconsistency may be differences in the type of exercise, the intensity of exercises, gender, and the physical fitness of the subjects[16, 17, 18, & 19]. It was widely believed in the 1920's and 30's that physical exercise leads to erythrocytosis. During intense physical exercise the concentration of erythrocytes can increase by 25 percent [20]. At first, this change was justified by mobilization of blood stores, since stored blood has many cells and little plasma in comparison to circulating blood. In dogs, the volume of spleen decreases by 70 to 87 percent during physical exercise. That is, 20 percent more erythrocytes are released into blood. However, exercise-induced increase in the number of erythrocytes can be associated with the release of stored cells elsewhere [21].

One of the important changes induced by physical exercise is leukocytosis or increase in the number of white cells in the blood that can amount to four times of the resting level and it can remain high for several hours after exercise. But exercise-induced leukocytosis depends on the intensity and duration of exercise and duration plays a much more

significant role [22]. Measuring the level of leukocytes in both groups indicated a significant relationship at different stages of sampling and this result if consistent with the findings of Karakoc et al. (2005) and Bahati et al. (2007) [9 & 17]. They concluded that the pressure from physical exercise significantly increases the number of leukocytes.

The level of platelets indicates significantly changed in two groups. Ahmadizad et al. (2005) carried out a research on the effect of resistance exercises on hematological factors in non-athlete men and examined the effect of such exercises on the activity and concentration of platelets in 13 subjects. They showed that all the exercises increase blood platelets and this increase is independent of the intensity of exercise [12]. This is consistent with the results of the present research. Other studies that are in line with the findings of the present research are Bahati et al. (2007), Karakoc et al. (2005), and Joksimovic et al. (2009) [10, 17, & 23].

Comparing the morning group and the afternoon group revealed that there is no significant different between them in the level of hemoglobin, platelets, leukocytes, and erythrocytes following a session of maximal aerobic exercise. As mentioned earlier, many factors influence physiological condition at different hours of the day including the internal temperature of the body, release of such hormones as melatonin, etc. As a result, human body undergoes many changes at different hours of the day and these can influence performance in exercises at different times.

The effects related to the biological clock of human body are two-faceted. First, the biological clock enables the individual to perform physical and mental activities and develops cardiovascular and biochemical changes with respect to these activities, increasing the level of physical and mental activity during the day and contributing to recovery during the night. The second role of the body's biological clock is to prepare the individual for shifting from the active state to sleeping state and vice versa. Release of melatonin is negatively related to core body temperature, where it increases in the evening when core body temperature drops and decreases in the morning when core body temperature rises [24].Generally during maximal aerobic exercises, the population of red blood cells may increase. Moreover, these exercises lead to change in the number and distribution of leukocytes and platelets in the blood. It may as well lead to proliferation of lymphocytes. Redistribution of leukocytes is attributed to the hormonal changes during and immediately after exercise. Exercise-induced changes in the number, distribution, and proliferation of leukocytes are transient [25].

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