ARTICLE

INVESTIGATING THE EFFECT OF REGULAR AEROBIC ACTIVITY ON YOUNG FEMALES HEMATOLOGY

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ABSTRACT

Introduction: *Physical activity, as a complementary element of a healthy lifestyle, has numerous advantages. It suggests the healthy impacts of exercise and the correlation between physical activity with appropriate frequency, intensity, time, and health. Therefore, the aim of this study was to determine the effect of eight weeks of aerobic exercise on serum levels of red blood cells, hemoglobin, hematocrit, and platelet in young females.* ***Methods:*** *This research is a quasi-experimental study. In this study, 30 females studying at the Jahrom University of Medical Sciences were participated voluntarily. They were assigned in two groups experimental group (n=15) with an mean age 21.93 ± 2.34, height 157.93 ± 4.57 , weight 60.00 ± 8.09 and BMI 24.10 ± 3.20 and control group (n=15) with mean age 22.33 ± 2.69, height 168.60 ± 10.54, weight 66.60 ± 13.15 and BMI 23.33 ± 3.53. The experimental group program includes eight weeks of running, three times a week with 60 to 65 percent of maximum heart rate for 45 minutes and with observing the principle of overload until the eighth week of 75 to 80 percent of maximum heart rate. To measure blood factors (red blood cells, hemoglobin, hematocrit, and platelet), blood samples were taken from participants in two stages (72 hours before and eight weeks after executive program). In order to analyze the data, independent t test was used.* ***Results:*** *The results showed that comparing hematologic factors in the experimental group increased red blood cells (p<0.009), hemoglobin (p<0.0001), hematocrit (p<0.0001), and platelet (p<0.001) significantly compared to the control group.* ***Conclusion:*** *Considering the results of this research, it can be concluded that regular exercises can have positive effects on red blood cells, hemoglobin, hematocrit, and platelet of people, especially the young females.*

KEY WORDS
aerobic activity, red blood cells, hemoglobin, hematocrit, platelet, young females

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INTRODUCTION

Exercise, as one of the physical activity options, can be effective not only at championship dimension, but also in maintaining the body's health. However, its implementation and intensity should be so that its side effects to be reduced in terms of health [1]. In studies conducted in this regard, it has been stated that blood tissue plays an important role in exercise activities due to transporting blood to cells, disposal of waste material, the sustainability of the body fluids, hormones, being involved in regulating hemostasis in blood glucose, and hormonal adaptations during exercise activities. Conflicting studies have been conducted so far to investigate the impact of these factors on exercise and physical activities [2]. Considering the incorrect form of exercise and its impact on blood changes of athletes, it has been stated that changes in red blood cells depend on intensity and type of activity performed and the readiness of individuals, so that in high-contact exercises like Kung Fu and the activities carried out with high intensity, a significant decrease was found in the number of red blood cells due to the increased vascular hemolysis [3]. Reduction in blood indices level can decrease oxygen transport to active tissues. As a result, oxygen required for aerobic metabolism of muscle cells decreases. Accordingly, the active muscles supply their needed energy from anaerobic pathways and their dependency to immediate fuels [glycogen and creatine phosphate] increases. This mechanism leads to the accumulation of lactic acid, increased perception of fatigue, and depletion of immediate energy stores, which ultimately creates fatigue and decreased performancein athletes [4]. Therefore, exercise without considering its correct form, can leave harmful effects on body and effort in performing correct form of exercise can increase the efficiency of the body, especially the blood factors of athletes. Some studies have shown that the number of circulating red blood cells can increase as result of release of stored red cells in the spleen induced by physical activity [5]. Research has shown that exercise causes increased red blood cells, so that concentration of red blood cells can increase by 25% during the exercise [6].

Exercise hematology has taken great steps in the past 30 years and it has been emerged as a specialized sub-branch of science [7, 8]. Physical activity that increases physical power causes a wave of change in the body, including peripheral blood erythrocytes system. It was also reported that inactivity reduces plasma volume and total volume of red blood cells, leading to reduced circulating blood volume and reduced performance of body [9] and the number of red blood cells in active tissues increases while performing physical activity. This phenomenon is created due to increased blood flow associated with an increase in the number of red blood cells and slight increase in hemoglobin and hematocrit immediately after the exercise [10].

In addition, it has been stated that increased red bloods leads to increased blood concentration, increased capability in carrying oxygen from blood, leading to increased performance and efficiency during physical activity. On the other hand, physical work capacity and the maximum oxygen consumption in humans depend on transporting oxygen to tissues involved in activity. In addition, blood performance is determined under the influence of factors like Circulating blood volume, oxygen-carrying capacity of blood by hemoglobin by [7].

As mentioned, these changes in some cases may cause a risk to health and athletic performance can be reduced. Increased blood viscosity impairs oxygen delivery to the muscles and body tissues and it causes

resistance against capillary blood circulation, fatigue, and reduced ability in athletic performance [11]. Studies on exercise activities effects on hematological variables continue, so that researchers have found contradictory results on the impact of physical activities on these variables. Despite significant developments in the various areas of hematology and exercise, the long-terms effect of aerobic exercises on blood factors has not been clearly stated and there are many conflicts in this regard. As women and girls are always exposed to anemia and decreased blood elements for a variety of causes such as menstruation and pregnancy at different stages of life, the investigation of impact of aerobic activities on blood elements, especially in females, seems to be necessary. Therefore, with regard to what was said above and importance of the issue, the aim of this study was to investigate the effect of aerobic training on hematological changes, especially in young females.

MATERIALS AND METHODS

This research is quasi-experimental study and it is applied in terms of objective. The study population consisted of 30 female students of Jahrom University of Medical Sciences [25-18 years old] who participated voluntarily in the study. A sample of 30 subjects was assigned in two groups of experimental [aerobic exercise] and control groups, each containing 15 subjects. After selecting subjects, they were informed of research topic, objective, method, as well as applications and potential risks of the study.
Pre-test session was hold one day before exercises to assess weight, height, and body composition. Height and weight were measured by wall stadiometer and digital scale, respectively. For weight measurement, the subjects stood beside wall without shoes and socks, so that back of them was stuck to wall and their head position was toward forward. Then, their weight was recorded in kilograms. To measure the weight, subjects stood on the scale and their weight was recorded in kilograms. Then, subjects were divided into two experimental and control groups.

The experimental group exercise program included eight weeks running, three times a week with 60 to 65 percent of maximum heart rate for 45 minutes at the beginning by observing overload principle, reached to 75 to 80 percent of maximum heart rate until eighth week. Exercises started with 15-minute warm-up including stretching and jogging started and ended with 15 minutes of cooling down the stretching. The control group received no regular exercise during the study and they continued their normal activities before the study. Blood samples were taken 72 hours before and 72 hours after the last exercise session to determine the pre-test and post-test**.**

Before blood sampling, subjects took a break for 20 minutes. Then, venous blood sampling was performed from the subjects' right hand in a sitting position to assess red blood cells, hemoglobin, hematocrit, and platelet. In this study, descriptive statistics was used to describe the collected data and inferential statistical methods were used to test the hypotheses. In the descriptive statistics section, indicators of mean and standard deviation were used. Then, independent t-test was used to intergroup means comparing. SPSS 18 software was used to calculate the statistical results of study. Significance level was also $p<0.5$.

Findings

Demographic characteristics of research participants included age, height, weight and body mass index [BMI] shown in [Table 1]. The mean age in the control group and experimental group was 22.33 ± 2.69 and 21.93 ± 2.34 years, respectively that significant difference was not found in this regard. The mean height in the experimental group and the control group was 168.60 and 157.93 cm, respectively.
In addition, mean weight in the control group and experimental group was 66.6 and 60.0 respectively, which significant difference was not found between them in this regard, and body mass index in the experimental group and control group was 24.1 Kg per m^2 and 232.33 Kg per m^2, respectively.

Table 1: Descriptive variables of subjects studied

Variable group	nfeatures mean and SD		
Experimental group	15	Age [years]	34.2±21.93
		Height [cm]	54.4±157.93
		Weight [kg]	09.8±60.00
		Body mass index [Kg per m^2]	20.3±24.10
Control group	15	Age [years]	69.2±33.22
		Height [cm]	54.10±168.60
		Weight [kg]	15.13±66.60
		Body mass index [Kg per m^2]	53.3±23.33

Descriptive statistics of variables of hemoglobin and red blood cells in the experimental group and the control group are shown in [Table 2]. The results show that the control and experimental groups was significantly different in pre-test in terms of descriptive statistics. The concentration of red blood cells, hemoglobin, hematocrit, and platelets in the experimental group in pre-test stage was close to the control group. In the post-test experimental group, the increase in red blood cells, hemoglobin, hematocrit and platelet was observed compared to pre-test groups, indicating the effect of exercise carried out in this

study of the investigated factors. However, in the post-test control group compared to pre-test group, significant changes were not observed in red blood cells, hemoglobin, hematocrit, and platelet.

Table 2: Descriptive statistics of subjects studied

platelet	Hematocrit	Hemoglobin	Red Blood Cell	variable stages	
66.7±178.33	91.1±40.40	69.0±12.92	45.0±69.4	Pre-test	Experimental
91.66±252.93	56.2±90.44	34.1±15.42	31.0±074.5	Post-test	
27.7±177.40	11.2±40.16	91.0±70.12	41.0±57.4	Pre-test	Control
72.7±26.177	04.2±40.20	75.0±83.12	45.0±53.4	Post-test	

To compare the variables of study in the pre-test stage, independent t-test was used for subjects in both experimental and control groups. [Table 3] shows that the homogeneity assumption of the subjects is confirmed in pre-test considering non-significance of research variables in two control and experimental groups.

Table 3: Compares of research variables in the pretest stage for subjects in both control and experimental groups

statistic Variable		Mean difference	SD	T value	Significance
Experimental and control groups	Red Blood Cell	0.054	0.16	0.334	0.741
	Hemoglobin	0.23	0.29	0.790	0.436
	Hematocrit	0.074	0.74	0.100	0.921
	Platelets	1.21	2.73	0.443	0.661

To compare Red blood cell between experimental group and control in post-test stage, independent t-test was used. [Table 4] shows the results of this test. Independent t-test results showed that in the post-test stage, there is significant difference between control and experimental groups in terms of the effect of aerobic exercise on red blood cells.

Table 4: Results of independent t-test [variable of red blood cells in the two groups]

Statistic Group		mean±SD	Mean difference±SD	n	Levin test for equality of variances F coefficient	Significance	T value	df	Significance
Red Blood Cell	Experimental	5.074±0.31	0.544±0.15	15	.0118	.0733	.0018	28	.0009
	Control	4.53±0.45		15					

To compare hemoglobin between experimental group and control in post-test stage, independent t-test was used. [Table 5] shows the results of this test. Independent t-test results showed significant difference between control and experimental groups in terms of the effect of aerobic exercise on hemoglobin in the post-test stage.

Table 5: Results of independent t-test [hemoglobin variable in the two groups]

Statistic Group		mean±SD	Mean difference± SD	n	Levin test for equality of variances Coefficient F	Significance	T value	df	Significance
Hemoglobin	Experimental	15.42±1.34	2.59±0.45	15	4.306	0.047	5.386	28	0.0001
	Control	12.83±0.75		15					

Independent t-test results in [Table 6] showed significant difference between control and experimental groups in terms of the effect of aerobic exercise on hematocrit in the post-test stage.

Table 6: Results of independent t-test [hematocrit variable in the two groups in post-test stage]

Statistic / Group		mean±SD mean±SD	Mean difference±SD	n	Levin test for equality of variances: Coefficient F	Levin test for equality of variances: Significance	T value	df	Significance
Hematocrit	Experimental	44.90±2.56	4.7±0.99	15	0.411	0.527	4.139	28	0.0001
	Control	40.20±2.04		15					

As Levin test did not confirm the homogeneity of variances significant, we reported modified t-test results. Independent t-test results in [Table 7] showed that significant difference between the experimental group and control group in terms of the effect of aerobic exercise effect on platelets variable in post-test stage.

Table 7: the results of independent t-test [platelet variable in two studied groups in post-test stage]

Statistic Group		mean±SD mean±SD	Mean difference±SD	n	Levin test for equality of variances: Coefficient F	Levin test for equality of variances: Significance	T value	df	Significance
Platelet	Experimental	252.93±66.91	75.67±18.10	15	22.55	0.0001	4.2	15.487	0.001
	Control	177.26±7.72		15					

DISCUSSION

Serum levels of red blood cells in young females changed significantly after eight weeks of aerobic activity. According to results of this study, red blood cells in experimental groups increased significantly compared to control group and this difference was significant [p<0.009].

Results of this study were in line with results of study conducted by Ramazanpoor et al [2001] who examined the effect of aerobic exercise on hemoglobin, red blood cells, hematocrit, iron, serum ferritin, and transferrin in young females. They showed a significant increase in the red blood cells in subjects [12]. Ramazani et al [2012] examined the effect of eight weeks of resistance periodic and continuous exercise on some hematologic parameters in non-athlete males. The results showed that the levels of red blood cells, hemoglobin, hematocrit, increased significantly in three groups [13].

Marjani et al [2009] examined the effect of one session of physical activity on some blood elements of athletes and the results showed that the level of red blood cells was significantly increased at the end of exercise [14]. Additionally, the results of this study were in line with results of Mousavi Zadeh et al. [2009] who examined the effect of aerobic exercise on hematological indices in female students and they found significant reduction in hematologic indices of young females [15]. Dehghan and Pouya [2012] examined the effects of 8 weeks of exercise on blood factors of young females and they found no significant differences in red blood cells, haemoglobin, and haematocrit [16] that it was not consistent with the results of our study. Lack of consistency between current study and presented studies can be justified by intensity and duration of readiness exercise of subjects, difference in type of exercise presented, exercise pressure, and base level of blood levels.

Physical activities, especially aerobic activities, increase blood circulation and increased need of muscles to oxygen, so that oxygen consumption in the muscles is 100 times than resting time [17]. Additionally, the primary driver for the production of erythropoietin is the amount of oxygen available to meet the metabolic needs of the body tissues that it is one of the causes for increased need of body tissues to oxygen of aerobic physical activity [18]. In this regard, the occurrence of hypoxia conditions during exercise and adaptations resulting from exercise cause an increase this hormone from the kidneys and liver in small quantities.

Therefore, regular exercises increased releasing of red blood cells through hormone aritropoitin [19, 20]. Hence, the results of this research will be justified that the regular exercises have led to increased hormone aritropoitin, increased blood flow, and finally increased red blood cells in young females. It is in line with the previous studies conducted in this regard. Serum hemoglobin values of young females changed significantly after eight weeks of aerobic activity. According to the results of the research, hemoglobin value increased in the experimental group compared to control group, that this difference was statistically significant [P<0.0001]. The results of this investigation were in line with results of a study conducted by Ramazani et al [2012], who examined the effect of eight weeks of resistance periodic and continuous exercise on some hematologic parameters in non-athletic males. The results showed that the levels of red blood cells, hemoglobin, and hematocrit increased significantly in three groups [13]. Gray [1993] studied the effect of aerobic exercise on blood hemoglobin and the results showed that aerobic

exercise increased significantly the hemoglobin concentration after exercise [21]. Marjani et al [2009] examined the impact of one session of physical activity on some blood elements of athletes and hemoglobin level increased at the end of exercise [14, that it was in line with result of our study. Ghanbari Niaki et al [2006] examined the effects of three-day non-consecutive running on hematology variables and observed a significant decrease in hemoglobin levels, that it was inconsistent with this study. One reason of consistency of this study with presented studies could be participation of young subjects [20]. Lack of consistency of the present study with presented studies could be reasons of differences in size and duration and frequency of exercise program. The need to increased oxygen during exercise can provoke hematopoietic cells to produce more oxygen carriers [12]. Since 92 percent of the oxygen in the blood is carried by hemoglobin, there is high correlation between oxygen-carrying capacity and range of hemoglobin density [14]. In addition, as hemoglobin contains 33.5% of internal compounds of red blood cells, it is obvious that an increase in red blood cells is followed by increased hemoglobin [22]. According to the results of this research, it can be stated that there is a positive and linear relationship between increased hemoglobin and increased red blood cells. Hence, the need for more oxygen provokes oxygen carriers [hemoglobin, and subsequently red blood cells] to supply body oxygen as result of physical activities. Therefore, the results of this research indicated that exercises increased the values of hemoglobin in the subjects.

Serum levels of hematocrit young females changed significantly after eight weeks of aerobic exercise. According to the results of this study, levels of hematocrit in the experimental group increased compared with the control group and this difference was statistically significant [$p<0.0001$].

The results of research are in line with results of study conducted by Ramezani et al [2012] on the effect of eight weeks of resistance periodic and continuous exercise on some hematologic parameters in non-athletic males. The results showed that the levels of red blood cells, hemoglobin, and hematocrit increased significantly in three groups [13]. Several factors can be responsible for changes in hematocrit during sports activities, including the change and displacement of fluids, reduced water, and the release of red blood cells from the spleen [15]. Additionally, changes in fluids and dehydration and decreased plasma volume can lead to increased hematocrit [6]. Given that hematocrit is the percentage of red blood cells, then it is possible that hematocrit percentage increase due to increased red blood cell [14]. The results of this study suggest that the increase in red blood cells and hemoglobin can be a major cause of

increased hematocrit in the subjects, but plasma and reduced blood viscosity during physical activities should not be ignored in this regard. However, as lack of plasma volume control was limitation of this study, increase in percentage of red blood cells can increase the level of hematocrit in subjects.
Serum levels of platelets in young females after eight weeks of aerobic activity increased significantly. According to results of this study, platelet values increased in the experimental group compared with the control group, and this difference was significant [$p<0.001$]. The results of this research are in line with results of study conducted by Marefati et al [2012] who compared the effect of aerobic exercise on blood platelets of young females. The results showed that aerobic exercise caused significant increase in blood platelet of subjects [23].

Platelet increase mechanism could be due to increased blood return from the vascular bed spleen, bone marrow and the accumulation of pulmonary artery blood flow within the muscles involved [2], because it has been reported that injection of epinephrine causes strong vasoconstriction of spleen, where about one-third of platelets are stored. This mechanism can explain the reason for increase in the amount of circulating platelets in the exercise [24]. According to results of this study, exercise in this research caused an increase in the level of blood platelets of young females by creating spleen contraction due to increased levels of epinephrine.

CONCLUSION

The results of the investigation showed that the regular exercises caused an increase in blood elements studied in young females by increasing the hormone erythropoietin, and increased blood flow. Therefore, the use of regular exercises and activities is recommended by observing scientific principles in order to increase the factors of red blood cell, hemoglobin, hematocrit, and platelet in people. Therefore, according to the results of this research, it is recommended for educational institutions to take measures to reduce the health problems of the students and to reduce blood problems of this class of society by planning the efficiency of the exercises in the academic area of students.

CONFLICT OF INTEREST
To the best of our knowledge, no conflict of interest exists.
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