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Effects of a Low Intensity Circuit Resistance Exercise Session on Some Hematological Parameters of Male Collage Students

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Abstract

This study aims to survey the effects of a circuit resistance training session with a light intensity on some hematological parameters of male students of Physical Education. After the release of an announcement and call, 20 male students of Physical Education voluntarily participated in this study. After equalization, they were randomly divided into two groups including light-intensity exercise (35% of a maximum repetition) and no exercise (the control). Persons in the first group were asked to perform 10-step circuit exercise for three non-stop alternating rounds with a rest period at each round. Hematological parameters measured included white blood cells, platelet variables, and red blood cells. Data was analyzed using SPSS software. To compare the means before and after the exercise and to compare to groups with each other, dependent t-test and independent t-test were used, respectively. Results showed that none of the variables related to white blood cells and platelet had a significant change in the group of light-intensity exercise (35% of a maximum repetition) and only mean corpuscular volume (MCV), among the variables related to red blood cells, decreased significantly. In the control group, a significant increase in neutrophil percent (NEUT) and hemoglobin and a significant decrease in lymphocyte percent (LYM) were observed. Other variables showed no significant change in this group. In addition, there was no difference between the groups.

Keywords: Circuit Resistance Exercise, mean corpuscular volume, neutrophil percent, hemoglobin, lymphocyte percent.

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Introduction

Blood is a liquid tissue that its main function is to maintain the steady state of internal environment of body tissues or, in other words, to keep the homeostasis (1). Like other organs of the body, blood does not have the same response to any physical activity. Type, intensity, time, and duration of activity are involved in the response of body to different activities (2). Oxygen carrying capacity is determined by hemoglobin concentration and number of erythrocytes of blood. Hence, the importance of hematological parameters in providing the consuming oxygen and ultimately in efficacy of body become more clear. Many observations have shown that blood composition changes as a result of exercise. Szygula *et al* concluded that physical exercises, totally facilitate increased physical work and Increased peak of oxygen consumption, cause a series of changes in the body including in erythrocyte system of peripheral blood (3). Platelets (Thrombocytes) are small circular or oval plates with a diameter of 1 to 4 micro meters. Platelets are originated from extremely large cells belonging to hematopoietic cells in the bone marrow called "Megakaryocytic". Megakaryocytic are fragmented and become platelets either in the bone marrow or immediately after entering the blood (1). Immune system is one of critical systems that its proper function ensures the health of individuals. If this system fails to act correctly, survival would be impossible, because our body is constantly exposed to the invasion of bacteria, viruses, fungi, and parasites and all these agents exist even in normal circumstances (1). The number of circulation of white blood cells and platelets by dynamic physical activities in humans can rapidly increase (4). However, debates on the effects of exercise on hematological parameters still continue. While some studies indicate an increase in hematological parameters after intensive training exercise, some other studies show that hematological parameters after exercise did not change significantly, especially in trained athletes (5). Since most studies on the effects of physical activity on blood serum parameters have yielded conflicting results and little research is available about the effects of resistance training on hematological parameters, the question raises that how circuit resistance trainings affect hematological parameters such as Platelet (PLT), Platelet Distribution Width (PDW), Mean Platelet Volume (MPV), Platelet-Large Cell Rate (P-LCR), White Blood Cell count (WBC), Lymphocyte percent (LYM), Neutrophil percent (NEUT), Mixed Cell percent (MXD), Red Blood Cell count (RBC), Red Distribution Width (RDW), Hemoglobin (Hb), Hematocrit (Hct), Mean Corpuscular Volume (MCV), and Mean Corpuscular Hemoglobin (MCH) in students of Physical Education.

Materials and Methods

Subjects: 20 male students of Physical Education of Shomal University of Amol, Mazandaran Province, Iran were randomly selected among those eligible, after the release of an announcement and call. Conditions for selection of subjects included non-use of drugs and supplements and also medication, personal health, and not having the history of blood diseases or diseases affecting platelet variables. The mean age, weight, height, and BMI (Body Mass Index) in light-intensity exercise (35% of a maximum repetition) group were 19.85±0.55 years old, 84.42±8.28 kg, 1.75±3.25 m, and 27.11±1.84 kg/m^2, respectively and in the control were 21.71±0.18 years old, 72.07±5.26 kg, 1.74±3.41 m, 23.44±1.42 kg/m^2, respectively. Weight and height of were measured by digital scale BEURER (model ps06m42, made in Germany) and scaled wall and BMI was calculated by the following formula Weight/Height^2.

Exercise protocol: On study day, the subjects were asked to do an exercise with weight including 10 motions (Biceps with barbell, sit-up, triceps with barbell, trunk extension, ninety-degree Scott, supine bench press, knee flexion, standing shoulder press, dead lift, and sitting paddle lift with device) with 35% of a maximum repetition in 3 rounds. In this exercise which lasted 21 minutes, a 5-minute gentle warm-up was done at first, each station (motion) took 20 seconds (8-10 repetitions on average) with no rest period, and there was one minute of active rest after each round.

Blood samples: 10^{cc} bloods were taken from brachial vein of the subjects using venoject needles before and immediately after the exercise session while they were sitting. In order to equalize the dietary conditions of subjects before the training session, they were asked to fast for at least 12 hours. Blood samples were taken immediately to the laboratory and centrifuged with 1500 rounds for 10-15 minutes. Then, the supernatant fluid (blood plasma) was taken immediately and used for measurement of white blood cells variables (WBC,

NEUT, LYM, MXD), platelet parameters (PLT, PDW, MPV, P-LCR), and red blood cells variables (RBC, HGB, HCT, MCV, MCH, RDW). Plasma volume was calculated using the formula based on hemoglobin and hematocrit (6). All above-mentioned variables were measured by the automated system of hematology analyzer of Sysmex (kx-21).

Statistical Analysis: Dependent t-student and independent t-student were used to compare the difference between data related to before and after the training session and to compare two experimental groups with each other, respectively. All data are presented in mean ± standard error. The mean difference was considered significant at an alpha level of 0.05 ($\alpha \leq 0.05$). All obtained data were analyzed using SPSS.

Results

Statistical analyses show that in the exercise group with 35% of one maximum repetition, only MCV had a significant decrease but other tested blood variables showed no significant change; PLT, PDW, MPV, P-LCR, WBC, NEUT, RBC, HGB, and MCH had an insignificant increase (p=0.107, p=0.302, p=0.073, p=0.121, p=0.131, p=0.150, p=0.308, p=0.334, and p=0.962, respectively), while LYM, MXD, HCT, RDW, and PV had an insignificant decrease (p=0.146, p=0.139, p=0.621, p=0.291, and p=0.920, respectively) (Table 1). In the control group, NEUT (p=0.006) and HGB (p=0.031) showed a significant increase, LYM (p=0.016) and PV (p=0.05) had a significant decrease, PLT (p=0.066), MPV (p=0.319), P-LCR (p=0.362), WBC (p=0.057), and MXD (p=0.726) showed an insignificant increase, and PDW had an insignificant decrease (p=0.647) (Table 1).

Table 1. hematologic parameters of (Mean ± SE)

Variables	Group	Pre-Test	Post-Test	p Value
PLT (× 10^3/ µL)	Exercise	189.11 ± 9.64	266.88 ± 19.94	0.107
	Control	179.7 ± 5.08	206.5 ± 9.91	0.066
PDW (fL)	Exercise	11.93 ± 0.66	12.9 ± 0.79	0.302
	Control	11.26 ± 0.29	10.46 ± 1.78	0.647
MPV (fL)	Exercise	9.44 ± 0.25	10.13 ± 0.36	0.73
	Control	9.03 ± 0.17	9.53 ± 0.38	0.319
PLC-R (%)	Exercise	21.92 ± 1.88	26.6 ± 2.79	0.121
	Control	19.53 ± 1.18	22.41 ± 2.65	0.362
WBC (× 10^3/ µL)	Exercise	6.01 ± 0.41	7.16 ± 0.53	0.133
	Control	6.01 ± 0.35	6.85 ± 0.45	0.057
NEUT (%)	Exercise	65.33 ± 1.66	69.44 ± 1.75	0.15
	Control	63.9 ± 1.1	68.8 ± 0.91	0.006**
LYM (%)	Exercise	31.55 ± 1.71	27.55 ± 1.89	0.146
	Control	33.4 ± 1.06	29.2 ± 1.15	0.016*
MXD (%)	Exercise	3.22 ± 0.4	2.99 ± 0.28	0.139
	Control	2.7 ± 0.44	3.00 ± 0.44	0.726
RBC (× 10^6/ µL)	Exercise	4.4 ± 0.43	4.88 ± 0.17	0.308
	Control	4.85 ± 0.22	5.18 ± 0.21	0.299
Hb (g/L)	Exercise	15.31 ± 0.2	15.87 ± 0.47	0.334
	Control	13.98 ± 0.51	15.47 ± 0.55	0.031
Hct (%)	Exercise	46.05 ± 0.59	45.3 ± 1.2	0.621
	Control	43.23 ± 1.07	44.58 ± 0.91	0.323
MCH (pg)	Exercise	32.58 ± 0.38	32.61 ± 0.48	0.962
	Control	29.38 ± 1.72	30.26 ± 1.49	0.658
RDW (%)	Exercise	12.34 ± 0.17	10.96 ± 1.2	0.291
	Control	13.57 ± 0.69	13.15 ± 0.52	0.654
MCV (fL)	Exercise	98.03 ± 1.09	93.11 ± 1.48	0.01**
	Control	90.36 ± 3.85	86.9 ± 3.04	0.413
PV (%)	Exercise	53.94 ± 0.59	53.54 ± 3.48	0.92
	Control	56.77 ± 1.07	50.55 ± 2.38	0.05*

PLT: Platelet count, **PDW:** Platelet Distribution Width, **MPV:** Mean Platelet Volume, **P-LCR:** Platelet-Large Cell Rate, **WBC:** White Blood Cell count, **LYM:** Lymphocyte percent, **NEUT:** Neutrophil percent, **MXD:** Mixed Cell percent, **RBC:** Red Blood Cell count, **RDW:** Red Distribution Width, **Hb:** Hemoglobin, **Hct:** Hematocrit, **MCV:** Mean Corpuscular Volume, **MCH:** Mean Corpuscular Hemoglobin, **PV:** Plasma Volume, ***:** Significance in 0.05, ****:** Significance in 0.01.

In addition, no significant difference was observed between the exercise group with 35% of one maximum repetition and the control group (Table 2).

Table 2. mean differences of hematologic parameters of Groups (Mean ± SE)

Variables	Control	Exercise	p Value
PLT (× 10^3/ µL)	26.8 ± 12.83	37.77 ± 20.83	0.652
PDW (fL)	-0.8 ± 1.64	0.96 ± 0.87	0.319
MPV (fL)	0.5 ± 0.45	0.68 ± 0.33	0.737
PLC-R (%)	2.88 ± 2.87	4.67 ± 2.69	0.666
WBC (× 10^3/ µL)	0.84 ± 0.38	1.15 ± 0.69	0.057
NEUT (%)	4.9 ± 1.35	4.11 ± 2.57	0.784
LYM (%)	-4.2 ± 1.42	-4.00 ± 2.48	0.944
MXD (%)	0.3 ± 0.83	-0.55 ± 0.33	0.373
RBC (× 10^6/ µL)	0.32 ± 0.29	0.18 ± 0.16	0.68
Hb (g/L)	1.49 ± 0.58	0.56 ± 0.55	0.269
Hct (%)	1.35 ± 1.29	-0.75 ± 1.46	0.294
MCH (pg)	0.88 ± 1.91	0.22 ± 0.45	0.684
RDW (%)	-0.42 ± 0.9	-1.38 ± 1.22	0.53
MCV (fL)	-3.46 ± 4.46	-4.92 ± 1.46	0.748
PV (%)	-6.21 ± 2.85	-0.39 ± 3. 8	0.233

PLT: Platelet count, **PDW:** Platelet Distribution Width, **MPV:** Mean Platelet Volume, **P-LCR:** Platelet-Large Cell Rate, **WBC:** White Blood Cell count, **LYM:** Lymphocyte percent, **NEUT:** Neutrophil percent, **MXD:** Mixed Cell percent, **RBC:** Red Blood Cell count, **RDW:** Red Distribution Width, **Hb:** Hemoglobin, **Hct:** Hematocrit, **MCV:** Mean Corpuscular Volume, **MCH:** Mean Corpuscular Hemoglobin, **PV:** Plasma Volume.

Discussion

The present study examined the effect of a circuit resistance training session on some hematological parameters such as PLT, PDW, MPV, P-LCR, WBC, NEUT, LYM, MXD, RBC, HGB, HCT, MCV, MCH, and RDW. In terms of significant increase of in NEUT and HGB and significant decrease in LYM in the control group, due to the significant decrease in PV after the exercise than before the exercise and presence of no significant difference between groups, it can be concluded that these changes are because of decreased plasma volume and haemoconcentration (7, 8). No significant change was observed in other hematological parameters of the control group.

Results firstly show that the selected activity of the present study did not induce any significant change in parameters related to platelets and white blood cells. Platelets show responses to exercise and physical activities that are depended on many factors including exercise intensity, exercise duration, and individual fitness indices (9). Increase in WBC cycle, occurring during physical activity, depends on exercise intensity and duration and individual fitness indices (10). On the other hand, Nyman and other researchers believe that even the type of activity, gender, and age are determining factors in the extent of changes of the immune system (11). A study observed that a session of intense aerobic activity to the limit of fatigue can significantly increase the number of leukocytes, monocytes, neutrophils, eosinophils, and lymphocytes (12). Another also found an increase in WBC after an increasing aerobic exercise session in young and adult athletes, while this increase was more associated with neutrophils and lymphocytes (13). But a research observed no significant change in the number of leukocytes as well as neutrophils and lymphocytes after a judo tournament. This is attributed to delay in blood sampling in this study (14). A report showed a significant increase in WBC and PLT levels after a 24-hour ultra-marathon race (15). Another also reported a significant increase in the number of white blood cells, monocytes, and mixed lymphocyte after a wrestling training session (10). Indeed a study observed a significant increase in WBC and PLT after a 90-minute football training session (16). But another found no significant change in WBC and PLT after 12 weeks of intense physical activity

(17). Some studies have been also done on the effect of resistance exercises on leukocytes. A research also reported a significant increase in leukocytes after three different types of exercise (A five-minute session of riding on a ergometer bicycle with 90% of intensity, 2 hours riding on a ergometer bicycle with 60% of intensity, and a circuit training session with weight) (18). Another study observed a significant increase in PLT and MPV after three types of resistance training with intensities of 40%, 60%, and 80% of one maximum repetition. However, it should be noted that their exercise were not circuit (19). Tayebi *et al* also observed a significant increase in WBC, PLT, and MPV in the blood of 10 students of Physical Education after a session of continuative-periodic circuit resistance training (No rest at the stations) (7). Ghanbari *et al* also found a significant increase in PLT, MPV, P-LCR, and WBC after a session of circuit resistance training in 14 students of Physical Education (8). Tayebi *et al* in a study observed a significant increase in MPV and PLT and no significant change PDW and P-LCR in young weightlifters (20). Also, they found a significant increase in PLT, MPV, and P-LCR and no significant change in PDW among the students of Physical Education (20). In a study observed a significant increase only in WBC in young weightlifters. Additionally, none of the variables related to white blood cells showed a significant change among students of Physical Education (21). In the last two mentioned studies, differences between groups were very small (20, 21).

Among the variables of RBC, only MCV showed a significant decrease in the present study. Karakoc found a significant decrease in HGB and MCV and no significant change in RDW and RBC. He attributes the significant decrease in HGB and MCV to haemodilution caused by shear rate occurring at the end of training session and also increased content of Na^+ of plasma which facilitates the fluid entry into the plasma space (16). Since plasma volume showed no significant change after 21 minutes of exercise in the group of circuit resistance training with 35% of one maximum repetition, the observed decrease in MCV can be attributed to the effects of exercise. Boyadjiev *et al* compared erythrocyte variables among young adult elite boy and girl athletes from different sports and stated that observed changes in boys and girls is affiliated to the exercise, certain sports have similar effects in both males and females, and continuation of intense exercises causes a decrease in red blood cell parameters in young adult boys and girls. The latter mostly applies to submaximal sports (22). A study observed no significant change in RBC, MCV, MCH, MCHC,RDW, HGB, and HCT (15). Fujitsuka also found no significant decrease in HGB and RBC (17). Tayebi *et al* reported a significant decrease in RDW and a significant increase in MVC in 10 students of Physical Education after a session of circuit resistance training (7). Another study also observed a significant increase in MCV and a significant decrease in RDW after following a training session of circuit resistance training similar to the training program of the present study in 14 students of Physical Education (8).

Conclusion

Despite the available information, the point that is not exactly answered is that what volume of exercise intensity can have the best impact on hematological parameters and how possible changes in blood parameters can be optimally used to increase physical work and exercise capacity. Given that few papers have been published on the effects of exercises and especially resistances exercise on hematological parameters, the importance of conducting studies on this topic becomes doubled.

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