World Applied Sciences Journal 21 (10): 1521-1529, 2013
ISSN 1818-4952

DOI: 10.5829/idosi.wasj.2013.21.10.2812

The Effect of Two Intensive Aerobic and Anaerobic Tests on Immune System in Male Athletic Students in Iran

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Abstract: The aim of this study was to investigate the effect of two intensive aerobic and anaerobic tests on leukocytes, neutrophils and monocytes subpopulation. In this cross-sectional study, 15 male athletic voluntaries to participate in this study and did two intensive aerobic and anaerobic tests in a 2 experimental trials separated by at least 10 day. Blood sample were taken before, immediately, 1 and 24 hours after tests to analysis number of circulating leukocytes, neutrophils and monocytes. A significant difference was found between number of leucocytes before, immediately, 1 and 24 hours after aerobic test [$P \leq 0.05$]. A significant difference was found between number of neutrophils before, immediately, 1 and 24 hours after aerobic test [$P \leq 0.05$]. A significant difference was found between number of monocytes before, immediately, 1 and 24 hours after aerobic test [$P \leq 0.05$]. A significant difference was found between number of leukocytes before, immediately, 1 and 24 hours after anaerobic test [$P \leq 0.05$]. A significant difference was found between number of neutrophils before, immediately, 1 and 24 hours after anaerobic test [$P \leq 0.05$]. A significant difference was found between number of monocytes before, immediately, 1 and 24 hours after anaerobic test [$P \leq 0.05$]. These data demonstrate that intensive aerobic test was inducing increase leucocytes, neutrophils and monocytes, spatial in macrophage system. And also demonstrate that intensive anaerobic test was not inducing signification varied in immune system. The result is that a maximal aerobic test increase and strength the immune system and anabolic state can exercise testosterone and research has shown that this hormone can reduce immune system components.

Key words: Aerobic · Anaerobic · Athletic · Leukocytes · Neutrophils · Monocytes · Phagocytosis · Iran

INTRODUCTION

Physical activity effect on the body immune system is one of the issues that often considered by sport physiology experts. Immune system is responsible to protect the body against foreign and pathogenic factors [1]. Many people believe that the high and intensive activity, increase the immune system resistance. However researches about the effects of intensive and long-term exercise on the immune system, Showed the upper respiratory infection and immune factors destruction [2-6].

The effect of exercise on the immune system function and changes on body immune system has been observed in most past researches. Studies show changes in the immune system which related to exercise is depend on exercise intensity (high, medium, low), type (aerobic, anaerobic), individual condition (beginner, professional, elderly, young, female and male), measurement methods (invasive and non-invasive) and time of participation in the exercise) pre-season, season, out of season competition) [4, 6]. During the last decade, investigation about the athletes immune system indexes (humeral, cell) have expanded impressively [2]. Based on these studies, there is some evidence that show, athletes during the heavy training are more susceptible to disease and continuing training or competition may threaten the health of the athletes. Moreover, according to the open window hypothesis, athletes after intensive exercise are more susceptible to infection diseases [2-7].

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Considering the aforesaid explanation regarding to possible weakening in the immune system after intensive exercise and as this factor is one of the most important factors for the athletes health which may cause poor performance of athletes because of upper respiratory infection and the contradictions in this case [6, 8-15], this study is going to answer, what is the effect of both aerobic and anaerobic tests on white blood cells (leukocytes) and some of its Subclass (neutrophils and monocytes) in the male students athletes.

Nielsen *et al*., (1999), examined the effects of 6 minutes rowing on the aerometry, during 2 days (3 sessions per day), in 8 men outboard (vo2max 5/5 L/min). Blood Signs before, during and 24 hours after each exercise was measured. In comparison with resting levels, the first training effort increased the amount of Leukocyte, neutrophil granulocytes and lymphocytes twice. Also during the last exercise immune components level increased, so Leukocyte, neutrophil granulocytes and lymphocytes amount increased to triple, triple and quadruple respectively. During recovery period (2 hours after each attempt) values return to resting levels. These results show that maximal exercise with large muscle groups will stimulate greater immune responses during repeated attempts [16].

Wolach *et al*., (1998) compared the effects of exercise on the immune system of 7 gymnastic girls with 6 non-athletes girls. The age ranges of participants were 10-12 years old. Gymnasts had trained 22 hours per week and non-athlete girls did participate only 2 to 4 hours per week in physical education classes and dance. The Wingate anaerobic exercise test was used after 30 seconds maximal effort on aerometry. The result of the Wingate anaerobic exercise showed that leukocyte significantly increased but it is not significant difference between groups. Similarly, a significant increase in neutrophils and lymphocytes in both groups occurred after the test immediately. The number of lymphocytes and neutrophils were reached to prior of exercise after 24 hours. Increase in monocytes, basophils, eosinophil and platelets following the Wingate test were not significant. Finally, these changes are similar to immune changes in adults with similar training efforts [8].

Yamada *et al*., (2002) examined 12 winter athletes on a maximal treadmill test. Their blood samples were collected max two hours after the exercise. The results indicate that the amount of neutrophils increased an hour after exercise and even remained up to 2 hours after exercise [17].

Robson *et al*., (1999), in their study showed that 3 hours exercise at 55% vo2max make more changes in the total leukocyte and neutrophils function and glutamine concentrations than 1 hour exercise at 80% of vo2max (38 minutes). In addition, 24 hours after short duration intense exercise (38 minutes) leukocytes function returned to the before practice level, but neutrophils function in low intensity long-term training (3 hours) still remained suppress significantly at 24 hours after training. Thus, long-term exercise sessions, can suppress immune performance in athletes [18].

Shor *et al*., (1999), examined the relationship between volume of exercise and immune function of intense training. In this study, 33 inactive new student men ages 19 to 29 years old were participated. Subjects trained in 12 weeks (3 sessions per week), 60 minutes per session with maximum 60% heart rate. In contrast, another group with 18 young men exercises five times in a week, with an intensity of 75-80% of maximum heart rate. Finally they stated that the best exercise from immune performance point of view is low volume exercise [19].

Clow and Bridge (2001), believe that immune function is under pressure and the pressure of elite athletes in competition may lead to immune suppression and so increases chronic infection. They also stated that a intense activity combined with an immune response that is substantially similar to the reactions that are stimulated by infection and it related with increase in the number of blood leukocytes [especially neutrophils and lymphocytes], which is depends on the intense and duration of exercise [20].

Konig *et al*., (2000), with an overview of the epidemiological evidence and a questionnaire survey conducted in Freiburg, showed that transient exercise that is high intensity with high pressure, thereby Causes increase the incidence of upper respiratory infection .Whatever light exercises are gentle as a guard against infection [21].

Gleeson *et al*., (2000), in their research as an immune response mucous and risk of respiratory illness in elite athletes announced that after the intensive training, Immunoglobulin concentration (A and M) reduced immediately and after 24 hours the rest return to normal. They expressed lack of immunoglobulin levels cause respiratory disease risk factors as they have stated that the repression of these safety factors depends on exercise intensity and volume [22].

MATERIALS AND METHODS

The method of this research is semi-experimental design with One-Group Pretest-Post-Test.

Subjects: We selected the subjects among 40 male students of physical education department of Ardebil University within 20-25 years old which at least had three years regular sport experience. For this purpose we used a questionnaire and finally 15 students were selected by simple random sampling. The volunteers must be healthy and didn't have coronary heart disease or specific diseases (diabetes, hypertension). Also the selected subjects should not have problems such as cold, infections and medications to prevent the effects of infection and drug consumption in white blood cells numbers.

Variables: Independent variable: Type of activity; aerobic (Ellestad test), anaerobic (Faulkner Cunningham test).

Dependent Variables: Blood leukocytes, neutrophils and monocytes.

Research Tools and Method of Measurement: The following tools used for performing this study:

- Testimonial form
- Results record form
- Health form
- For collecting data of body composition and body fat percentage, Lange model caliper is used. Body fat percentage was measured by three point Jackson - Pollack model.
- Seca height and weight measurement device was used for measuring the height and weight of subjects.
- Treadmill used for Ellestad and Faulkner Cunningham test.
- Santo device and electrical transmitter to measure subjects heart rate.
- Cotton, alcohol, syringes for venesection.
- Test tube and anticoagulant for collecting blood and prevent clotting blood.
- Sphygmomanometer to measure blood pressure of subjects.

Food Conditions of Subjects: According to our research goal and necessity of performing pretest and post test in this study, so subjects should be stayed in student dormitories and used self-service meals. Also athletes were advised to use only self-service meals 48 hours prior testing. The subjects ate breakfast at 7 am (butter, honey, Juices) on practical testing day and they were prepared for practical implementation 2 hours after breakfast.

Assessments: The subjects didn't do any sport activities 48 hours before the test, then at a certain time (9 am and 2 hours after breakfast); test was performed in the Laboratory of the University. First of all, blood pressure and rest heart rate was measured after 5 minutes relaxation and then their height and weight were measured with using scales and Seca. Then layer of subcutaneous fat, were measured with a Lange caliper. Thereupon, first stage blood sample were taken from subjects right hand, then subjects warmed up with five minutes stretching the large muscles and 3 minutes kinetic motion. Santo electrical transmitter installed on subjects chest to control heart rate and then the subjects performed test on the treadmill. Test execution time was recorded by stopwatch. Immediately after test completion, subjects' heart rate recorded and blood sample (second stage) was obtained. After second blood sampling stage, the subjects had relaxation and after one hour the third blood sampling were obtained from the subjects. This test procedure was performed for aerobic (Ellestad) and anaerobic test (Cunningham Faulkner) that were done with two weeks distance. Aerobic and anaerobic tests were done within 3 days and 2 days respectively.

Statistical Analysis: Descriptive and inferential statistics has been used to classify and arrange data and paired t-test was applied to compare mean scores variables. Also for research hypotheses test, analysts at variance with repeated measures to prove significant and because of the repeated measurements is a comparison of methods of test for the existence of significant was used Newman cowls in various iterations.

RESULTS

Table 1 shown the mean and standard deviation of subjects' individual characteristics such as height, weight, age, BMI, rest heart rate, fat percentage, rest blood pressure and running time in anaerobic test.

The results of variance analysis with repeated measures on aerobic leukocytes number in Table 2 showed The number of changes in blood leukocyte aerobic subjects before, immediately, one hour and 24 hours after the test aerobic Ellestad test is significant (001/0> P).

Based on Newman Cowles' test, there is significant deference between mean scores in aerobic blood leukocyte before, immediately, one hour and 24 hours after the test (P<0/05)

The results of variance analysis with repeated measures on aerobic neutrophils number in Table 4 showed The number of changes in blood leukocyte aerobic subjects before, immediately, one hour and 24 hours after the test aerobic Ellestad test is significant (001/0> P).

Based on Newman Cowles test, there is significant deference between mean scores in aerobic blood neutrophils before, immediately, one hour and 24 hours after the test (P<0/05).

The results of variance analysis with repeated measures on aerobic monocytes number in Table 4 showed The number of changes in blood leukocyte aerobic subjects before, immediately, one hour and 24 hours after the test aerobic Ellestad test is significant (003/0> P).

Based on newman colwes test, there is significant deference between mean scores in aerobic blood monocytes before, immediately, one hour and 24 hours after the test (P<0/05).

The results of variance analysis with repeated measures on anaerobic leucocytes number in Table 8 showed The number of changes in blood leukocyte aerobic subjects before, immediately, one hour and 24 hours after the test aerobic Faulkner Cunningham test is significant (001/0> P).

Based on newman colwes test, there is significant deference between mean scores in anaerobic blood leucocytes before, immediately, one hour and 24 hours after the test (P<0/05).

The results of variance analysis with repeated measures on anaerobic neutrophils number in Table 10 showed The number of changes in blood leukocyte aerobic subjects before, immediately, one hour and 24 hours after the test aerobic Faulkner Cunningham test is significant (001/0> P).

Based on Newman Cowles test, there is significant deference between mean scores in anaerobic blood neutrophils before, immediately, one hour and 24 hours after the test (P<0/05).

The results of variance analysis with repeated measures on anaerobic monocytes number in Table 12 showed The number of changes in blood leukocyte aerobic subjects before, immediately, one hour and 24 hours after the test aerobic Faulkner Cunningham test is significant (001/0> P).

Based on newman colwes test, there is significant deference between mean scores in anaerobic blood monocytes before, immediately, one hour and 24 hours after the test (P<0/05).

For comparison mean score leukocyte aerobic - anaerobic subjects paired t test was used. As can be seen in Table 1 between scores of aerobic - anaerobic Leukocytes one hour and 24 hours after test after test, there are significant differences.

Table 1: The mean and standard deviation of subjects' individual characteristics

Variables	Height [cm]	Weight [KG]	Age [year]	BMI [Kg/cm2]	Rest heart rate	Body fat percentage	Rest blood pressure	Anaerobic running time [min]
Mean	176.06	72.200	22.4	23.51	71.80	13	1.70	2.58
Standard deviation	6.45	8.13	1.35	1.19	10.68	3.5	0.16	0.31

Table 2: Summary analysis of variance with repeated measures on aerobic blood leukocytes of subjects before, immediately, one hour and 24 hours after the test Ellestad.

Source of change	Square total	Free degrees	Mean square	F	P
Between individual	118135999/8	14		24/31	P < 0/001
Interpersonal	128600000	45			
Leukocytes	81604000	3	27201333		
Result	46996000	42	1118952/4		
Total	375335999/8	59			

Table 3: Comparison means score aerobic leukocytes in difference repeat with Newman Cowles

Condition	Post test	1 hour post test	24 hour post test
Pretest	*3000	873/33	340
Post test	-	*2126/67	*26660
1 hour post test	-	-	533/33

Table 4: Summary analysis of variance with repeated measures on aerobic blood neutrophils of subjects before, immediately, one hour and 24 hours after the test Ellestad.

Source of change	Square total	Free degrees	Mean square	F	P
Between individual	89123426	14		8/451	P < 0/001
Interpersonal	67023589	45			
Leukocytes	25228731	3	8409576/8		
Result	41794858	42	995115/67		
Total	223170604	59			

Table 5: Comparison mean score aerobic neutrophil in difference repeat with Newman Cowles

Condition	Post test	1 hour post test	24 hour post test
Pretest	*1713/13	1014/67	395/67
Post test	-	698/47	*1317/47
1 hour post test	-	-	619

Table 6: Summary analysis of variance with repeated measures on aerobic blood monocytes of subjects before, immediately, one hour and 24 hours after the test Ellestad.

Source of change	Square total	Free degrees	Mean square	F	P
Between individual	269244/43	14		5/481 P < 0/003	
Interpersonal	671318/5	45			
Leukocytes	188877/60	3	62959/20		
Result	482440/90	42	11486/69		
Total	1611881/43	59			

Table 7: Comparison means score aerobic monocytes in difference repeat with Newman Cowles

Condition	Post test	1 hour post test	24 hour post test
Pretest	*123/20	45/60	24
Post test	-	77/60	*147/20
1 hour post test	-	-	69/60

Table 8: Summary analysis of variance with repeated measures on anaerobic blood leucocytes of subjects before, immediately, one hour and 24 hours after the test Faulkner Cunningham.

Source of change	Square total	Free degrees	Mean square	F	P
Between individual	68779333	14		45/03 P < 0/001	
Interpersonal	375642500	45			
Leukocytes	286549833	3	95516611		
Result	89092667	42	2121254		
Total	820064333	59			

Table 9: Comparison means score anaerobic leucocytes in difference repeat with Newman Cowles

Condition	Post test	1 hour post test	24 hour post test
Pretest	*4733/33	493/33	393/33
Post test	-	*5226/67	*5126/67
1 hour post test	-	-	100

Table 10: Summary analysis of variance with repeated measures on anaerobic blood neutrophils of subjects before, immediately, one hour and 24 hours after the test Faulkner Cunningham.

Source of change	Square total	Free degrees	Mean square	F	P
Between individual	43105254	14		< 170/07	P < 0/001
Interpersonal	63751039	45			
Leukocytes	35028582	3	11676194		
Result	28722457	42	683868/03		
Total	170607332	59			

Table 11: Comparison means score anaerobic neutrophils in difference repeat with Newman Cowles

Condition	Post test	1 hour post test	24 hour post test
Pretest	*1756/67	288/53	1867
Post test	-	*1468/13	*1939/33
1 hour post test	-	-	471/20

Table 12: Summary analysis of variance with repeated measures on anaerobic blood monocytes of subjects before, immediately, one hour and 24 hours after the test Faulkner Cunningham.

Source of change	Square total	Free degrees	Mean square	F	P
Between individual	861125/73	14		12/75	P< 0/001
Interpersonal	2223903/3	45			
Leukocytes	1059964/6	3	353321/53		
Result	1163938/7	42	27712/83		
Total	5308932/33	59			

Table 13: comparison means score anaerobic monocytes in difference repeat with Newman Cowls

Condition	Post test	1 hour post test	24 hour post test
Pretest	*296/13	29/93	1/60
Post test	-	*326/07	*294/53
1 hour post test	-	-	31/53

Table 14: Comparison mean scores of leukocytes [WBC] Aerobic - Anaerobic

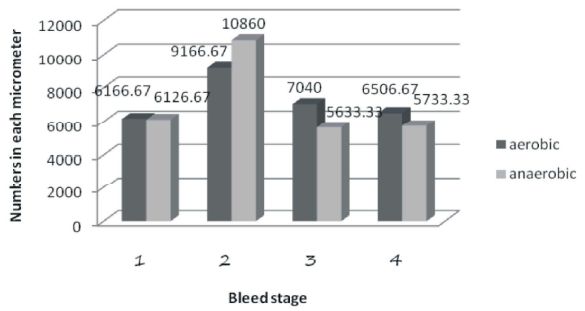
Variable	Condition	Mean	Sd	Free degree	t	P
Pretest WBC	Aerobic	6166/67	1437/59	14	0/90	0/93
	Anaerobic	6126/67	1100/95			
Post test WBC	Aerobic	9166/67	1873/37	14	-1/821	0/09
	Anaerobic	10860	2783/83			
WBC 1 hour after Post test	Aerobic	2073/91	7040	14	2/180	*
	Anaerobic	1200/39	5633/33			0/047
WBC 24 hour after Post test	Aerobic	1384/85	6506/67	14	2/016	*
	Anaerobic	934/77	5733/33			0/063

Table 15: Compared mean scores to neutrophils aerobic - anaerobic

Variable	Condition	Mean	Sd	Free degree	t	P
Pretest neutrophil	Aerobic	3340/60	11030/08	14	0/344	0/73
	Anaerobic	3204/93	1006/12			
Post test neutrophil	Aerobic	5053/73	1551/45	14	0/158	0/876
	Anaerobic	4961/60	1465/02			
Neutrophil 1 hour after Post test	Aerobic	4355/27	2133/70	14	1/367	0/193
	Anaerobic	3493/47	1121/54			
Neutrophil 24 hour after Post test	Aerobic	3736/27	1083/90	14	2/478	*
	Anaerobic	3022/27	845/05			0/027

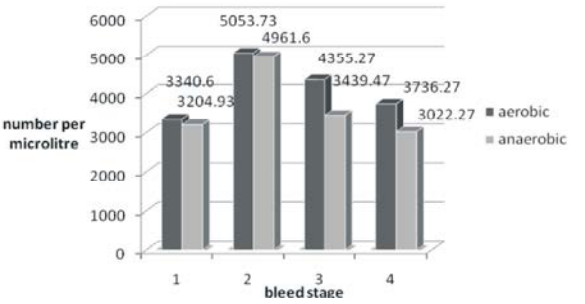
Table 16: Compared mean scores monocytes Aerobic - Anaerobic test

Variable	Condition	Mean	Sd	Free degree	t	P
Pretest Monocyte	Aerobic	222/93	130/82	14	1/144	0/272
	Anaerobic	168/87	109/62			
Post test Monocyte	Aerobic	346/13	150/51	14	-1/210	0/246
	Anaerobic	465	343/47			
Monocyte 1 hour after Post test	Aerobic	268/53	89/33	14	4/170	*
	Anaerobic	138/89	82/83			0/001
Monocyte 24 hour after Post test	Aerobic	220/27	77/09	14	0/805	0/434
	Anaerobic	3022/27	88/32			



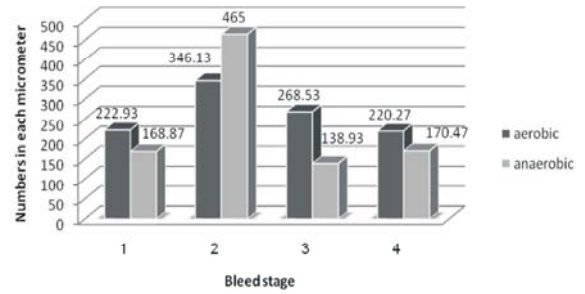
1 - prior to test 2 - Immediately after the third test - a test after 4-24 hours after the test.

Fig. 1: Comparison of aerobic - anaerobic leukocytes subjects before, immediately, one hour and 24 hours after the aerobic test [Ellestad] and anaerobic [Cunningham Faulkner]



1 - prior to test 2 - Immediately after the third test - a test after 4-24 hours after the test.

Fig. 2: Comparison of aerobic - anaerobic Neutrophils subjects before, immediately, one hour and 24 hours after the aerobic test [Ellestad] and anaerobic [Cunningham Faulkner]



1 - prior to test 2 - Immediately after the third test - a test after 4-24 hours after the test.

Fig. 3: Comparison of aerobic - anaerobic Monocytes subjects before, immediately, one hour and 24 hours after the aerobic test [Ellestad] and anaerobic [Faulkner Cunningham]

For comparison scores mean neutrophils aerobic - anaerobic subjects paired t test was used. As can be seen in Table 14 between the mean neutrophil aerobic - anaerobic 24 hours after the test there are significant differences.

For comparison mean scores for monocytes aerobic - anaerobic subjects paired t test was used as in Table 16 can be observed between the mean scores monocytes aerobic - anaerobic one hour after the test, there is significant difference.

DISCUSSION

As the main purpose of this study was investigating about influence of an intense aerobic and anaerobic exercise on blood immune system factor of male athlete students, 15 male athlete students within ages 20-25 years old participated in both aerobic and anaerobic maximal test. The distance between each test was 10 days.

Number of Blood leukocytes of subjects was investigated before, immediately, one hour and 24 hours after the Ellestad aerobic test. Research results indicate that the number of leukocytes increased.

Aghaalinezhad (1379), in a research showed that long-term exercise on aerobic threshold of 85 percent compare with the same activity but in 100% of aerobic threshold, Significantly increase in neutrophils number and leucocytes during and up to 4 hours after exercise [23]. Bizheh (1381)examined the eccentrics and concentric sport patterns on special immune indexes in women athletes and conclude that the amount of white cell in both groups increase significantly after exercise [24].

Oshida *et al* (1988), in their study on 5 untrained male and 6 trained male who have practiced for 2 hours with 60% maximum oxygen consumption, found that exercise increases the number of leukocytes in both groups [25]. The results of our research were same as other previous researches such as Aghaalinezhad [23], Bizheh [24], Eliakim et a l [8], Hack *et al* [26], Oshida *et al* [25] .

Number of Blood neutrophils of subjects was investigated before, immediately, one hour and 24 hours after the Ellestad aerobic test. Research results indicate that the number of neutrophils increased. kapell *et al* ,compared the changes in immune factors workout mild exercise vo2max 25%, moderate exercise vo2max 50% and hard training vo2max75%. They observed an increase only after intense exercise in leukocytes, particularly neutrophils and monocytes was continued until two hours after the operation [28]. Benoni *et al*, showed that after 10 minutes of bike riding on ergometry with heart rate

of 150, number of neutrophils has increased [27].Yamada *et al*, tested 12 winter sports athletes under a maximal treadmill and concluded that the number of neutrophils remained high until 2 hours after exercise [17]. The results of our research were consistent with researches of Aghaalinejad (1379) [23],Mackinon *et al* [28], Benoni *et al* [27], Hack *et al* [26], Oshida *et al* [25], Yamada *et al* [17].

Schrhag *et al*, examined the effect of 4 hours bike riding on ergometry with the 70% anaerobic threshold intensity. After training, the number of monocytes and neutrophils returned to baseline levels. It seems that time of exercise is important factor [29].

Number of blood monocytes of subjects was investigated before, immediately, one hour and 24 hours after the Ellestad aerobic test. Research results indicate that the number of monocytes did not change significantly. Niemen *et al* (2001), examined immune function of 20 elite women outboard and 19 non-athletes females whining ages 22-24 years old and concluded, there was no significant difference in the number of monocytes [30]. The results of our research were matched with researches of Baryga *et al* [32], Johnson and colleagues [31] and Niemen *et al* [30].

Number of blood leukocytes of subjects was investigated before, immediately, one hour and 24 hours after the Faulkner Cunningham anaerobic test. Our research results indicate that the number of leukocytes is reduced. Hack *et al* (1997) examined 8 weeks anaerobic exercise effects on the number of leukocytes and lymphocytes. As a result, after this intensive training course, number of leukocytes and lymphocytes activity reduced [13]. The results of our research were consistent with results of Hack *et al* [13], Laegreid *et al* [33].

Wolach *et al* (1998) examined a Wingate anaerobic test on the 7 gymnast female and 6 non athlete females' ages 10-12 years old by 30 seconds maximum effort on ergometry bike. They concluded that after 24 hours, the number of lymphocytes and neutrophils reached to before exercise level [8]. Nielsen *et al* (1999), tested the effects of 6 minutes rowing on the ergometer in two days (3 sessions per day) on the 8 outboard males. Blood samples was measured before, during and 24 hours after each exercise. As a result, during the recovery of leukocytes, neutrophils and lymphocytes returned to resting levels [16]. Results of our research were matched with Gabriel *et al* [34], Nielsen *et al* [16] and Wolach *et al* [8].

CONCLUSION

Briefly, according to the results of this study, intense aerobic exercise changes the blood immune factors. Results show that immediately after the test, number of leukocytes, neutrophils and monocytes increased significantly and in an hour after the test have been decreased but those were still higher than before the test. Also at 24 hours after the test, the leukocytes, neutrophils and monocytes number had a greater reduction, but number of leukocytes and neutrophils were still higher than before the test and number of monocytes reached to same value as before the test.

Meanwhile, the results of our study show that number of leukocytes, neutrophils and monocytes in an intense anaerobic exercise had significant increase immediately after the test and in an hour after the test, numbers of leukocytes and monocytes have decreased to below level than before the test while number of neutrophils remained higher than before the test. At 24 hours after the test, leukocytes had no change, neutrophils reduced and monocytes had a little increase than an hour after the test. Based on Pederson proposal, initial increases in leukocytes immediately after intense exercise is associated with rapid increase in epinephrine and growth hormone and the second is related to cortisol. In the recovery state, the effect of hormones has decreased and makes the components of the immune system returns to its original state. Besides testosterone hormones goes anabolic condition after exercise. Researches show that this hormone can reduce immune system components.

Finally our research indicate that a maximal aerobic test increase and improve the immune and phagocytosis system. Although this increase has no significant meaning, but if this trend continued in long term, probably will lead to improve the immune system. Meanwhile a maximal anaerobic test has no significant change in immune and phagocytosis system.

ACKNOWLEDGEMENTS

The authors declare that they have no conflicts of interest.

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