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# ACUTE EFFECTS OF AEROBIC AND ANAEROBIC EXERCISES ON CIRCULATION PARAMETERS[i]

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**Abstract:**
The aim of this study was to examine to acute effects of aerobic and anaerobic exercises on circulatory parameters. Twenty three sedentary male subjects were voluntarily participated in the study. Heart rate, systolic blood pressure and diastolic blood pressure parameters were measured with four different trials such as before warming up, after warming up, after anaerobic exercise, and after aerobic exercise, acutely. Repeated measures one way ANOVA and LSD correction tests were used for statistical analysis. According to obtained data, heart rate, and systolic blood pressure parameters showed statistically changes between trials ($p<0.05$). There was no difference between trials in diastolic blood pressure ($p>0.05$). Especially, after anaerobic trial, circulation parameters showed marked changes. In summary, it can be said that warm-up, anaerobic exercise, and aerobic exercise acutely affect circulation parameters.

**Keywords:** aerobic, anaerobic, circulation

## 1. Introduction

The most important organ in circulation is the heart. In exercises, the first action emerges in the heart as a reaction to the effect. Exercise has some effects on human body system (Pancar et al., 2017; Özer et al., 2017; Mahmood et al., 2017; Yilmaz et al., 2017; Özdal et al., 2017b). The most common effect of exercise on the cardiovascular system is

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to prevent the oxygen requirement of the heart by increasing the oxygen capacity of the organism (Özdal et al., 2017a). Heart rate and heart volume increase during exercise. With exercise, venous blood flow increases. The heart volume is adjusted when the intensity of exercise changes. During adjustment, firstly heart rate increases. The tendency to increase continues until to the steady stead that the oxygen needs of the body meet (Muratlı and Yaman, 1997). Significant reductions in heart rate have been achieved in long-term regular exercises, the short-time practices show the opposite, despite the finding that the strain of the contraction of the heart is caused by increases in the volume of the heart (Solak et al., 2002).

Circulation is one of the main factors affected by exercise and affecting exercise performance. The knowledge of the acute change of the circulation after aerobic and anaerobic exercises is important for training planning. It is known that carbohydrates and fats, even proteins, stored for use as energy in our body, generates energy by forming a number of chemical reactions when necessary. This energy is used chemically in our body and the ATP emerges as the form of energy. Energy metabolisms have organisms in the cell. The oxygen system takes place in these organelles within the organelle called mitochondria (Ergen et al., 2002). Carbohydrates and fats are generally used as an energy source in aerobic systems, and energy is produced in the body by these nutrients. After this reaction, carbon dioxide and water come out. Positive changes are showed in circulatory system in long-term aerobic activities (Keskin and Tuner, 1998). Lactic acid which occurs during exercise and causes fatigue does not occur in this system (Akgün, 1989).

When the muscle starts to contract, the energy required is supplied from the anaerobic system. In the first 10 seconds of exercise only creatine phosphatase is effective, however ATP production continues dominantly. The organism provides the required energy by introducing the anaerobic system, which is a second step for 1-3 minutes of exercise (Tangianu et al., 2011). In this system, the stored glycogen is used for energy producing. At the end of all these processes, the amount of energy produced is approximately 2-3 ATP (Berger et al., 2015; Horiuchi et al., 2015). The aim of this study was to examine to acute effects of aerobic and anaerobic exercises on circulatory parameters.

## 2. Material and Method

Our study was designed according to the trial-controlled cross test design for repeated measurements. Twenty three sedentary male subjects participated in the study in 20-25 age groups (Table 1).

**Table 1:** Descriptive Characteristics

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Age (year) | 23 | 20.00 | 24.00 | 22.48 | 1.16 |
| Height (cm) | 23 | 167.00 | 188.00 | 179.13 | 6.06 |
| Weight (kg) | 23 | 60.00 | 76.00 | 70.09 | 6.38 |
| BMI (kg/m$^2$) | 23 | 18.41 | 25.95 | 21.87 | 2.07 |
| Anaerobic power (W/kg) | 23 | 9.00 | 14.67 | 10.91 | 1.23 |
| Aerobic power (ml/kg/min) | 23 | 21.73 | 47.10 | 31.55 | 7.50 |

cm: centimeter, kg: kilogram, W: watt, ml: milliliter, min: minute

Power analysis was conducted with GPower 3.1 program for determining the number of subjects. Subjects also did not have a nutritional program. For this study, permission was obtained from Gaziantep University Clinical Research Ethics Committee. The subjects visited the lab four times. Each visit was made at the same time of day (16:00-20:00).

- Tests and exercise types to be prescribed in the first visit and voluntary consent forms were obtained.
- On the second visit, the circulation parameters were measured without warming up and the circulation parameters were measured again after 10 minutes of general warming.
- At the third and fourth visits, aerobic and anaerobic exercises were performed randomly (by picking the trial card) and then the same circulation parameters were measured. 14 subjects participated in the aerobic exercise at the third visit and 9 subjects participated in the anaerobic exercise at the third visit.
- All the measurements and tests were carried out in the Performance Laboratory of Gaziantep University School of Physical Education and Sports.

### 2.1. Acute Exercise Protocols

#### 2.1.1. Aerobic exercise protocol

The aerobic exercise protocol applied to the subjects was performed via a bicycle (My Bike 450F, Ergosana GMBH, Bitz, Germany) and an ergospirometer (Ergo100 PFT Systems, Medical Electronic Construction R & D, Brussel, Belgium).

At the beginning of the exercise, the pedal load was determined to be 50W and the exercise was continued by increasing 25W every minute. During the exercise, the subjects followed the screen and tried to pedal at 60 revs / min. Exercise is terminated when the subject decides that he can no longer continue (Özdal, 2015).

#### 2.1.2. Anaerobic exercise protocol

Wingate test protocol was applied for the purpose of acute anaerobic exercise trial. Subjects were weighed with an electronic scale before exercise and 7.5% of their body weight was placed on mechanism. The subject started to exercise by pressing the button when he wanted. With the beginning of the exercise, the subject was spoken orally motivated so that he could continue his performance. After the time was complete, the

test was terminated and the subjects were continuing to pedal for cool down (Özdal, 2015).

### 2.2. Circulation Parameters

#### 2.2.1. Heart rate measurement

After the subjects were allowed to sit in the chair for 5 minutes, the stethoscope was placed on the heart and the number of pulses was counted for 15 seconds. After the 15 s count, the number of heart beats was determined by multiplying by 4. Two measurements were made and the lowest one was recorded (Günay et al., 2010).

#### 2.2.2. Blood pressure measurements

The measurement was made with a stethoscope and arm manometer. The sphygmomanometer assembly was placed in the upper arm, just below the antecubital vein and just above the brachial artery (Günay et al., 2010).

### 2.3. Statistical Method

SPSS 22.0 program was used for statistical processing. After the normality and homogeneity testing, one-way analysis of variance and LSD correction were performed for repeated measurements. Values were presented as minimum, maximum, mean, standard deviation, standard error, and upper-lower 95% confidence interval and a significance level was determined as 0.05.

## 3. Results

Table 2 presents the analysis of heart rate change between trials. The result of one-way analysis of variance in repeated measures showed that the number of heart rate changed significantly pre and post warming.

**Table 2:** Analysis of heart rate change between trials

| | Mean±SD | Std. E. | %95 CI | | F | p | Difference |
|---|---|---|---|---|---|---|---|
| | | | Lower | Upper | | | |
| Pre warming | 74.70±13.75 | 2.87 | 68.75 | 80.64 | 93.793 | 0.001 | 2-1, 3-1, 3-2, 3-4, 4-1 |
| Post warming | 91.39±16.95 | 3.53 | 84.06 | 98.72 | | | |
| After anaerobic exercise | 144.09±18.62 | 3.88 | 136.03 | 152.14 | | | |
| After aerobic exercise | 93.17±26.77 | 5.58 | 81.60 | 104.75 | | | |

SD: standard deviation, CI: confidence interval

Table 3 presents the analysis of change of the systolic blood pressure between the trials. The result of one-way analysis of variance in repeated measures showed that there was a significant difference between the systolic blood pressure values measured after anaerobic exercise and the systolic blood pressure values measured after warm-up and after aerobic exercise.

There was also a significant difference between systolic blood pressure values measured after aerobic exercise and systolic blood pressure values measured before and after warming.

**Table 3:** Analysis of change of the systolic blood pressure (mmHg) between trials

| | Mean±SD | Std. E. | %95 CI | | F | p | Difference |
|---|---|---|---|---|---|---|---|
| | | | Lower | Upper | | | |
| Pre warming | 113.26±16.01 | 3.34 | 106.34 | 120.19 | 16.457 | 0.001 | 3-1, 3-2, 3-4 4-1, 4-2 |
| Post warming | 111.87±17.80 | 3.71 | 104.17 | 119.57 | | | |
| After anaerobic exercise | 133.91±18.55 | 3.87 | 125.89 | 141.94 | | | |
| After aerobic exercise | 125.30±17.85 | 3.72 | 117.59 | 133.02 | | | |

SS: standard deviation, CI: confidence interval

Table 4 presents analysis of change of the diastolic blood pressure between the trials. The result of one-way analysis of variance in repeated measures, there was no significant difference in diastolic blood pressures between the trials.

**Table 4:** Analysis of change of the diastolic blood pressure (mmHg) between trials

| | Mean±SD | Std. E | %95 CI | | F | p | Difference |
|---|---|---|---|---|---|---|---|
| | | | Lower | Upper | | | |
| Pre warming | 55.39±8.12 | 1.69 | 51.88 | 58.90 | 0.448 | 0.635 | - |
| Post warming | 54.39±9.26 | 1.93 | 50.39 | 58.40 | | | |
| After anaerobic exercise | 54.96±9.77 | 2.04 | 50.73 | 59.18 | | | |
| After aerobic exercise | 57.39±13.69 | 2.86 | 51.47 | 63.31 | | | |

SS: standard deviation, CI: confidence interval

## 5. Discussion and Conclusion

The aim of this study was to determine the acute effects of aerobic and anaerobic exercises on the circulation parameters such as heart rate, systolic blood pressure and diastolic blood pressure.

### 5.1. Acute effect of warming on circulation parameters

In this study, two warming treatments were carried out to be before and after warming, and the circulation parameters were measured separately. Measurements made prior to warming were evaluated in terms of control in order to demonstrate the effect of warming. Before warming up in the heart rate parameter, the average heart rate of the subjects was 74.70 ± 13.75 beats / min. After warming, the heart rate increased to 91.39 ± 16.95 beats / min. This difference was statistically significant ($p < 0.05$).

Before warming, the systolic blood pressure was measured as 113.26 ± 16.01 mmHg and 111.87 ± 17.80 mmHg after warming. Systolic blood pressure measurements before and after warming did not change ($p > 0.05$).

Before warming, the diastolic blood pressure was measured as 55.39 ± 8.12 mmHg and 54.39 ± 9.26 mmHg after warming up. Diastolic blood pressure measurements before and after warming did not change ($p > 0.05$).

When aerobic and anaerobic exercise practices and warming practices are compared; Systolic blood pressure significantly increased when compared to the values measured before and after warming after both aerobic and anaerobic exercise ($p < 0.05$). There was no statistically significant difference between diastolic blood pressures and exercise practices ($p > 0.05$).

Faigenbaum et al. found that warming increased acutely the number of heart rate in the study they conducted in 2005 and found that there was also a significant difference between the types of warming (Faigenbaum et al., 2005).

Mohr et al. reported that warming caused a significant increase in the number of heart rate as a result of warming in studies that effect of warming on body temperature in 2004 (Mohr et al., 2004).

In the present study, the other circulation parameters were not affected from warm-up, while heart rate was. Resulting of increased metabolic work with warming up, it was predicted result that heart rate could increase in order to support to required peripheral need. It can be considered that our findings related to these factors.

**5.2. Acute effect of anaerobic exercise on circulation parameters**

When the circulation parameters measured after anaerobic exercise trial are compared with other exercises; In the parameter of heart rate, the mean of the subjects after anaerobic exercise was measured as 144.09 ± 18.62 beats / min. In the systolic blood pressure parameter, the mean of the subjects after anaerobic exercise was measured as 133.91 ± 18.55 mmHg. In the diastolic blood pressure parameter, the mean of the subjects after anaerobic exercise was measured as 54.96 ± 9.77 mmHg.

Borresen and Lambert reported that the number of heart beats in their study in 2008 increased after intense exercise (Borresen et al., 2008).

In the present study, heart rate and systolic blood pressure affected from anaerobic exercise, but diastolic blood pressure was not. Resulting of increased metabolic work, it was predicted result that heart rate could increase in order to support to required peripheral need. It can be considered that our findings related to these factors.

**5.3. Acute effect of aerobic exercise on circulation parameters**

When the measured circulation parameters after aerobic exercise are compared with other exercises; in the heart rate parameter, the average of the subjects after aerobic exercise was measured as 93.17 ± 26.77 beats / min. In the systolic blood pressure parameter, the mean of the subjects after aerobic exercise was measured as 125.30±17.85 mmHg. In the diastolic blood pressure parameter, the mean of the subjects after aerobic exercise was measured as 57.39 ± 13.69 mmHg.

Albine and colleagues reported that in their study in 2010, the number of heart beats increased with aerobic exercise, and this increase persisted after exercise (Albinet et al., 2010).

Borresen and Lambert found that the study in which autonomic control of the number of heart beats were examined, the number of heart beats increases following aerobic exercise (Javorka et al., 2002).

Boutcher and Landers found that significant increases in heart rate both during exercise and immediately after exercise (Boutcher et al., 1988).

In this study, heart rate and systolic blood pressure affected from aerobic exercise, but diastolic blood pressure was not. It can be considered that is result of increased metabolic work. In summary, it can be said that warm-up, anaerobic exercise, and aerobic exercise acutely affect circulation parameters.

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