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The Effect of Short-Term Exercise on Oxygen Saturation in Soccer Players

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Abstract: The aim of this study was to investigate changes in oxygen saturation of soccer players with short-term exercise. For this purpose, two groups were generated from soccer players (n=10) and sedentaries (n=8). Wingate protocol was applied to the groups as a model for short-term exercise. Oxygen saturation (SpO_2) were measured before and immediately after the test. Also, age, weight with height data and bioelectrical impedance analysis, body mass index (BMI), basal metabolic rate (BMR), resting heart rate (HR_{rest}), systolic blood pressure (SBP), diastolic blood pressure (DBP), body fat percentage (%BF), fat mass (FM) and fat free mass (FFM) data were taken before the test. Paired Samples T for intra-group comparison and Independent Samples T tests to compare groups were used. According to analysis of pre-and post-test SpO_2 data of the groups, it was detected that there was a significant fall between the two tests in soccer players' group ($p<0.05$) and a fall in sedentary group but not significant ($p>0.05$). When the groups were compared, any significance was not found in SpO_2 data between two groups ($p>0.05$). As a result, it can be said that short-term exercise reduces the oxygen saturation but regular exercise doesn't affect the change in oxygen saturation in short-term exercise.

Key words: Soccer, Exercise, Oxygen Saturation (SpO_2).

INTRODUCTION

Maximal oxygen uptake (VO_2 max) of the person increases remarkably with controlled exercises increasing regularly and growing. Not only the increased one is VO_2 max, but also person's maximum respiratory minute volume and maximum heart minute volume show increase by affecting each other. A high aerobic capacity is converted to anaerobic capacity positively (Akgün, 1994).

The amount of oxygen carried depending on hemoglobin in the blood is named as SpO_2 and this forms the main mechanism for the transportation of oxygen to the cells (SpO_2 was used to indicate that a non-invasive measurement was realized using pulse oximeter in this study). Measurement of oxygen saturation gives information about hypoxia (Giuliano *et al*., 2005; Hakemi *et al*., 2005).

Arterial blood gas measurement and alternatively pulse oximetry are used for the measurements of oxygen saturation. There are advantages and reasons for choosing of both of the groups. The main important point is to know the accuracy of the the value of oxygen saturation detected by pulse oximetry and the factors affecting that. In many studies, the factors affecting the accuracy of pulse oximetry measurements have been investigated and were evaluated comparing with arterial blood gas (Louise *et al*., 1998; Van de Louw *et al*., 2001).

The use of pulse oximetry in the evaluation of oxygen saturation provides the individual continuous non-invasive measurement of both of the saturation and pulse without an invasive attempt (Woodrow, 1991).

The purpose of this study is to investigate the change in oxygen saturation with the effect of short-term exercise in soccer players and sedentaries and to provide data to the athletes, coaches and scientists with the results emerging.

MATERIAL AND METHOD

Subjects:

Licensed 10 male soccer players between the ages of 18-25 which makes the sport in the province of Gaziantep and 8 healthy male sedentaries as control group consists of the scope of the study. The subjects were randomly selected and signed a voluntary consent form. For this study, permission was obtained from Gaziantep University Clinical Research Ethics Committee.

Model of Anaerobic Exercise:

The most widely known and used one among laboratory tests to analyze anaerobic capacity or the capacity of short-term performance is Wingate test (Bar-Or, 1987). Wingate test was made in the ergometry of bicycle with model of Monark Ergomedic 894E. 75 grams resistance was applied to per kilogram of body weight. Bicycle saddle height is set to the length of each subject, and it was wanted the subjects to pedal without load and increase the speed gradually to warm up. Then, when pedal cycle speed reached to 100-120 rpm per minute,

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pre-set load in the bin fell automatically and the individual pedalled against this load for 30 seconds. During the Wingate test, subjects were motivated to pedal fast orally. Oxygen saturation measurements were taken before and immediately after the anaerobic exercise test.

Data Collection:
Pulse Oximetry Measurement:

SpO_2 measurements were taken from forefinger before short-term exercise and immediately after the test. The subject were informed about the aim and what measured before starting the procedures. The researcher informed the subject about the issue that the probe doesn't give any suffering and pain placing it to his/her finger firstly. Because of the fact that the liquid dried on the probe would be absorbed with the light and cause incorrect measurements, the probe was controlled and cleaned before each measurement. To prevent erroneous pulse oximeter measurements, it has been paid attention not to use bright fluorescent lamps in lightnening of the environment where the measurements were taken.

Body Composition:

Bioelectrical Impedance Analysis was applied to the subjects. BC-418MA model of Body Composition Analyser with the brand of Tanita is used for measurements. Thus, BMI, BMR, %BF, FM and FFM measurements of the individuals were determined (Mcardle *et al*., 1996; Gültürk *et al*., 2003). While measurements were taken, dress weight was extracted and conductivity of weighing, on which feet put, was increased cleaning it with a damp cloth.

Height and Body Weight Measurement:

While weight was measured with a weighing machine having 0.1 kg sensitivity and a metallic rod in this machine, height was measured digital height scale tool having 0.01 cm accuracy (Tamer, 2000).

SBP ve DBP Measurement:

SBP and DBP were measured with stethoscope and sphygmomanometer, blood pressure instruments (Zorba, 1999).

Statistical Method:

Before statistical procedures, whether the data was normally distributed and homogeneous was examined and statistical techniques appropriate for this were used. Paired Samples T Test for the intra-group analysis of SpO_2 pre- and post-tests of the groups and Independent Samples T tests to compare groups were used.

Results:

Table 1: Analysis pre- and post-test SpO_2 parameters of the groups.

SpO_2	n	Pre-Test		Post-Test		t	p
		Mean ± SD	Min - Max	Mean ± SD	Min - Max		
Soccer players	10	97.20 ± 1.26	95 – 98	95.40 ± 1.26	94 - 97	2.946	0.016*
Sedentaries	8	97.38 ± 1.30	96 – 99	96.50 ± 1.07	96 – 99	2.198	0.064

*p<0.05

Comparison of pre- and post-test measurement results, related to SpO_2 parameters, taken after exercises applied to the groups are shown in Table 1. There was a significance in SpO_2 value of the soccer players' group ($p<0.05$). Any significance was observed in SpO_2 data of sedentary group ($p>0.05$).

Table 2: Comparison of the groups.

Variable	Soccer Player (n:10)	Sedentary (n:8)	t	p
	Mean ± SD	Mean ± SD		
Age (years)	23.90 ± 2.02	21.63 ± 1.41	2.692	0.016*
Height (cm)	1.81 ± 0.07	1.78 ± 0.07	1.089	0.292
Weight (kg)	73.59 ± 7.99	69.95 ± 14.28	0.686	0.502
BMI (kg/cm^2)	22.32 ± 1.73	21.96 ± 2.81	0.333	0.744
BMR (kj/day)	1968.90 ± 204.96	1836.50 ± 287.21	1.142	0.270
HR_{rest} (pulse/min)	67.70 ± 5.89	72.38 ± 12.43	-0.979	0.352
SBP (mmHg)	109.30 ± 9.53	106.38 ± 8.16	0.688	0.501
DBP (mmHg)	71.30 ± 6.83	67.38 ± 8.16	1.133	0.274
% BF	8.29 ± 3.68	10.26 ± 4.92	-0.974	0.345
FM (kg)	6.21 ± 3.08	7.75 ± 5.02	-0.802	0.434
FFM (kg)	67.51 ± 7.22	62.20 ± 9.47	1.351	0.195
SpO_2 (%) (pre-test)	97.20 ± 1.23	97.38 ± 1.30	-0.292	0.774
SpO_2 (%) (post-test)	95.40 ± 1.26	96.50 ± 1.07	-1.960	0.068
SpO_2 (%) (pre-post test difference)	1.80 ± 1.93	0.88 ± 1.13	1.197	0.249

*p<0.05

Comparison of the measurement results, related to the parameters, taken after exercise applied to the groups are shown in Table 2. Data were significantly different between the groups in age ($p<0.05$). No significance was not found in any other data ($p>0.05$).

Dıscussıon:

The fact that VO_2 max, a determinant of aerobic capacity, is high allows athletes to conduct exercise longer in homeostatic conditions. During physical activity, 6 significant digits are known to determine how much atmospheric air oxygen used from alveoles moving to skeletal muscle mitochondria can be used (Taylor, 2008).

1. Oxygen uptake into the lungs via alveolar ventilation,
2. Passing of oxygen through alveolar-capillary membrane via diffusion,
3. Binding of oxygen with hemoglobin,
4. Reaching of oxygen to capillary in tissue levels through artery blood,
5. Diffusion of oxygen to mitochondria in capillary levels,
6. Usage of oxygen in oxidative phosphorylation and ATP production after use.

Working of any of these steps at high capacity by itself doesn't mean that more oxygen would be used by skeletal muscle tissue but a decrease in capacity of any of them will cause oxygen uptake decrease affecting all reactions (Kurdak, 2012).

The fact that the level of oxygen required for the performance in the arterial blood of the athletes cannot be maintained during heavy physical activity leads to the restriction in the capacity of these individuals. Due to the fact that oxygen content of the arterial blood is directly decisive in the aerobic sporty performance capacity, the factors influencing the body's oxygenation has become an interesting research subject by exercise physiologists and training scientists (Kurdak, 2012).

In our study, SpO_2 data was found 97.20±1.26 % on the pre-test and 95.40±1.26 % on the post-test in soccer players' group. SpO_2 data on the pre- and post-test were found 97.38±1.30 % and 96.50±1.07 % in sedentary group, respectively.

When pre- and post-tests of the sovver players' group were compared, a significance was observed with the level of $p<0.05$ (p:0.016). There was no significance in the sedentary group ($p=0.064$). However, the decline were found in both groups. This decrease is thought as muscle oxygen demand occuring in periphery as a result of acute exercise. Also, significance of decrease in the soccer players' group is thought due to the fact that the circulatory system adapts to the skeletal muscle's oxygenation as a result of regular training.

Barcroft indicated that there was a dcrease in oxygen saturation of arterial blood during exercise (Moazami, *et al*., 2013; Barcroft, 1975). Penaloza and friends similarly reported that they obtained a decrease in the oxygen saturation with exercise (Penaloza, *et al*; 1962). Similar results are indicated to be seen in the literature (Hosseini *et al*., 2013; West,*et al*., 1962).

When data was compared between the groups, there was significance in the mean ages of the groups but not in any other data.

Pre-tests, post-test and pre- and post-test differences in SpO_2 data of the groups were compared separately and no significance were found. The fact that there was no significance between pre-tests of the groups was found important in terms of the validity of the results. However, when pre- and post-test differences between the groups were compared, any significance was not found (Bijeh and Farahati, 2013; Vogel *et al*., 1962). This insignificance is thought to be due to the fact that the increase in both of the groups exhibits similar distribution.

In conclusion, it can be said that short-term exercise lowers the oxygen saturation of soccer players and this decrease is arised due to the sudden need of oxygen in skeletal muscle in line of our findings.

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