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BLOOD LACTATE AND LACTATE TOLERANCE LEVELS OF FUTSAL AND FOOTBALL PLAYERS

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ABSTRACT

The aim of this study is to determine futsal and football players' lactic acid levels, lactic acid tolerance and lactic acid content during recovery after maximal strength testing. Study sample consists of 80 voluntary male students (40 football and 40 futsal players) from different universities. The maximal heart rate was achieved during the Yo-Yo test in order to determine participants' running distances. After loading, participants' lactic acid levels were measured right at the end of the test and three minutes after the test. The running distance of futsal players was 1976 meters while that of football players was 2046 meters in the Yo-Yo test. Futsal and football players had a mean lactic acid concentration of 16.277 mmol/l and 14.512 mmol/l, respectively, right after the Yo-Yo test. Futsal and football players had a mean lactic acid concentration of 7.875 mmol/l and 7.705 mmol/l mmol/l, respectively, three minutes after the Yo-Yo test. Football players had a longer running distance than futsal players. Futsal players reached higher lactic acid concentrations and showed more tolerance to lactic acid than did football players during maximal strength testing. Futsal players recovered and removed lactic acid from their bodies faster than football players.

Key words: Lactic acid. Yo-Yo test. Futsal. football

RESUMO

Lactato sanguíneo e níveis de tolerância a lactato de jogadores de futsal e futebol

O objetivo deste estudo é determinar os níveis de ácido lático de jogadores de futsal e futebol, tolerância ao ácido lático e teor de ácido lático durante a recuperação após teste de força máxima. A amostra do estudo é composta por 80 estudantes voluntários do sexo masculino (40 jogadores de futebol e 40 jogadores de futsal) de diferentes universidades. A frequência cardíaca máxima foi alcançada durante o teste Yo-Yo para determinar as distâncias de corrida dos participantes. Após o carregamento, os níveis de ácido lático dos participantes foram medidos logo no final do teste e três minutos após o teste. A distância de corrida dos jogadores de futsal foi de 1976 metros, enquanto a dos jogadores de futebol foi de 2046 metros no teste Yo-Yo. Jogadores de futsal e futebol apresentaram concentração média de ácido lático de 16,277 mmol/le 14,512 mmol/l, respectivamente, logo após o teste Yo-Yo. Jogadores de futsal e futebol apresentaram concentração média de ácido lático de 7,875 mmol/le 7,705 mmol/l mmol/l, respectivamente, três minutos após o teste Yo-Yo. Os jogadores de futebol tiveram uma distância de corrida maior do que os jogadores de futsal. Jogadores de futsal atingiram maiores concentrações de ácido lático e mostraram maior tolerância ao ácido lático do que jogadores de futebol durante o teste de força máxima. Os jogadores de futsal se recuperaram e removeram o ácido lático de seus corpos mais rapidamente do que os jogadores de futebol.

Palavras-chave: Ácido lático. Teste de Yo-Yo. Futsal. Futebol.

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INTRODUCTION

Having been played in different forms since ancient times, football is definitely one of the most popular sports in the world. Football is a sport in which aerobic and anaerobic energy systems are used alternately.

Most football activities consist of off-the-ball movements with many aerobic features such as creating free space for the player with the ball, and deceiving and chasing the opponent (Günay, et al., 2018). Withers et al., report that an elite team player covers a distance of 11.500 meters during a game (Withers, et al., 1982).

Due to the duration of the game, the number of players and the size of the playing field, aerobic metabolism is used more dominantly than anaerobic metabolism in a game of football.

The importance of anaerobic efforts has increased as the pace of football has increased substantially in recent years and players have been more forceful in pressing counter-pressing and counterattacking in every zone of the field.

Players with the ball perform more anaerobically than aerobically to score. A player in a game uses anaerobic energy sources to sprint in 90 seconds and to engage in high-intensity effort every 30 seconds (Bangsbo, 1994).

Many studies indicate that elite football players have a maximum heart rate of 85-98% during a 90-minute game (Reilly, Thomas, 1997; Reilly, Bangsbo, Franks, 2000; Roi, et al., 1993).

Even if the maximal heart rate of players reaches 80-90% in a game of football, they are rested and recovered by walking and low speed running.

Futsal was developed in South America in the 1930's and introduced to Europe by Spain and Portugal (Barbero-Alvarez, et. al. 2008).

Due to the size of a futsal field and reduced number of players, futsal players engage in the game more than do football players playing in an open field. Given the characteristics of futsal, a good futsal player needs anaerobic strength, a powerful technique that can be used to adapt to any condition and a high level of game intelligence.

One main difference of futsal from football is that futsal players are allowed to rest and then enter the game again (Ocak, Buğdaycı, 2012).

The energy metabolism and physiological needs of futsal and football players are different during performance. The physiological needs of athletes during performance should be known in order for training programs to be effective.

The rules of football and futsal are essentially the same. However, they require different physiological needs in terms of game conditions.

One of the methods used to determine the physiology of football players is blood lactic acid (LA) concentration. Studies on this parameter show that the time and intensity of football bring with them some limitations. Some studies determined blood lactate concentrations at the end of each half in some matches or throughout the game in some practice and tournament matches (Helgerud, et al., 2001; Bangsbo, Mohr, Krustrup, 2006).

Although there are many studies on football players' $MaxVO_2$, MaxKAH and LA concentrations, the number of studies on futsal players' $MaxVO_2$, MaxKAH and LA concentrations is small.

Therefore, the aim of this study is to determine futsal and football players' lactic acid levels, lactic acid tolerance and lactic acid content during recovery after maximal strength testing.

MATERIALS AND METHODS

This study was approved by the Ethics Committee of Afyonkarahisar Clinical Research (Date: 10.05.2012, Decision No: 111).

The study sample consisted of 80 voluntary male students (40 football and 40 futsal players) from different universities. Written consent was obtained from participants and those who had an injury, were on medication and were not able to complete the test were not included in the study.

Measurement of Body Weight and Length

Body weight was measured to the nearest 0.01 kg on a scale, with participants barefoot and wearing shorts while body height was measured to the nearest centimeter.

Yo-Yo Test

A Yo-Yo intermittent endurance test consisting of a short active break of 5 meters (10 seconds) after each 20 m of running distance was used to measure participants' running distances and to ensure maximal strength.

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The test was started at a speed of 10 km/h and increased by the speeds in the test. The signal sounds in the licensed version of the test allow the speeds to increase periodically. If a participant misses the signal sounds 3 times or if he voluntarily withdraws from the test, it means the test is terminated. Polar pulse belt was used to ensure that participants reached maximum heart rate.

Measurement of Blood Lactate Levels

A lactate analyzer (Lactate Scout) was used to measure participants' blood lactate levels. Participants' lactic acid (LA) concentrations were measured in resting state prior to the test. LA measurements were made using blood samples from the distal end of participants' third or fourth hand fingers. The fingertips were first cleaned and then pierced with lancets (the first drop of blood was wiped off and second drop was used) and blood lactate measurements were performed using a strip. The lactate analyzer was standardized using the control drop before collecting blood. Afterwards, the Yo-Yo test was applied to football players on a dry grass field and to futsal players on an indoor sports hall with parquet flooring. Each participants' LA level was measured twice; right at the end of the test and 3 minutes after the test.

Data were analyzed using the SPSS. Tests of normality assumptions showed that the data were normally distributed, and therefore, parametric tests were performed. A paired-sample t test was used to compare within-group differences in first and last measurements and One-Way ANOVA tests were used to compare between-group differences in first and last measurements at a significance level of 0.5.

Findings

Table 2 shows that there is a statistically significant difference in LA levels between football and futsal players after the test ($p<0.05$).

Table 3 shows that there is a statistically significant difference in participants' LA levels between the first (right after the test) and second measurements (3 min after the test) ($p<0.01$).

Table 1- Demographics of Participants.

		n	Means	Std. Er.
Age (Year)	Futsal	40	21,95	1,616
	Football	40	22,58	1,907
Height (cm)	Futsal	40	174,42	4,645
	Football	40	176,73	5,368
Body weight (kg)	Futsal	40	70,05	3,113
	Football	40	71,47	3,486

Table 2 - Comparison of First Measurements of Football and Futsal Players.

Variable	Group	n	Means ± Stan.Dev.	t	p
Yo-Yo test running distances (meters)	Futsal	40	1976 ± 38,600	-1,289	,201
	Football	40	2046 ± 37,803		
Lactate before Yo-Yo test (mmol)	Futsal	40	1,67 ± ,0465	,707	,481
	Football	40	1,63 ± ,0485		
Lactate after Yo-Yo test (mmol)	Futsal	40	16,277 ± ,495	2,604	,011*
	Football	40	14,512 ± ,473		
3 minutes after Yo-Yo test (mmol)	Futsal	40	7,875 ± ,268	,382	,703
	Football	40	7,705 ± ,262		

Legenda: *p<0.01.

Table 3 - Comparison of First and Second Measurements of Participants.

Gourp	Variable	n	Means ± Stan.Dev.	t	p
Futsal	Lactate after Yo-Yo test (mmol)	40	16,375 ± ,487	19,134	,001*
	3 minutes after Yo-Yo test (mmol)	40	7,850 ± ,273		
Football	Lactate after Yo-Yo test (mmol)	40	14,512 ± ,473	13,325	,001*
	3 minutes after Yo-Yo test (mmol)	40	7,705 ± ,262		

Legenda: *p<0.01.

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Table 4 - Relationship between Participants' Yo-Yo distances and LA levels.

Variable	Group	n	Means ± Stan.Dev.	f	p
Yo-Yo Test	Football	40	1976 ± 38,600	1,662	,201
	Futsal	40	2046 ± 37,803		
Lactate after Yo-Yo test (mmol)	Football	40	16,375± ,487	7,513	,008*
	Futsal	40	14,513 ± ,473		
3 minutes after Yo-Yo test (mmol)	Football	40	7,850 ± ,268	,146	,703
	Futsal	40	7,705 ± ,262		

Legenda: *p<0.01.

Table 4 shows that there is a statistically significant difference in LA levels between football and futsal players only in the first measurement (p<0.01).

DISCUSSION

The mean age, height and weight of futsal players were 21.95 years, 174.42 cm and 70.05 kg, respectively, while those of football players were 22.58 years, 176.73 cm and 71.47 kg, respectively.

The mean resting LA levels of futsal and football players prior to the Yo-Yo test were 1.67 mmol/l and 1.63 mmol/l, respectively.

Akkoyunlu et al., (2004), reported that the mean resting LA level of amateur football players aged 14-16 years was 1.98 mmol/l. Özel and Özer (2017), found that the mean resting LA level of football players aged 19-21 years was 1.69 mmol.

Sporis et al., (2008), determined the mean resting LA level of 18 football players as 1.23 mmol while Arend et al., (2015), reported the mean resting LA level of football players aged 19-27 years to be 1.63 mmol.

Ocak, Sert (2020), in his study, stated that 22 male futsal players between the ages of 18-20 had lactic acid levels of 17.30 mmol after maximal loading. All in all, the results of previous studies indicate that the mean resting LA levels of football players are below 2, which is consistent with the result of this study.

The Yo-Yo Intermittent endurance test was developed by Bangsbo for team sports. Nowadays, it is widely used in many team sports based on intermittent load (Castagna, et al., 2003).

In the Yo-Yo test, the running distances of futsal and football players were 1976 and 2046 meters, respectively. The difference was not statistically significant. Many studies investigated the relationship between the Yo-Yo test and MaxVO2, and associated running distances with MaxVO2 (Rienzi, et al., 2000; Castagna, et al., 2003; Mohr, et al., 2003; Salvo, et al., 2007; Bangsbo, et al., 2008).

Evaluated the running performance of 6 goalkeepers, 21 backliners, 20 wing-backs, 22 center midfielders, 26 left- and right-midfielders and 24 forwards. They found that left- and right- midfielders had the longest running distance (Krustrup, et al., 2006).

Bangsbo, et al., (2008), classifies players according to Yo-Yo running distances as recreational players (1200-1300 m), moderate players (1810m), sub-elite players (2030 m), moderate-elite players (2190 m) and top-elite players (2420 m). According to this classification, the participants of this study are in the category of sub-elite players.

The mean LA levels of futsal and football players right after the Yo-Yo test were 16.277 mmol/l and 14.512 mmol/l, respectively. This difference was statistically significant (p<0.05).

Özel and Özer, (2017), reported that the mean LA level of football players after match was 13.65 mmol while Sporis et al., (2008), found that male football players had lactic acid levels of 15.4 mmol after maximal strength testing. The results of this study are higher than those reported by previous studies and the mean LA level of futsal players is higher than that of football players.

Futsal players can move very quickly on the field, take an active role in offense and defense, play well on one-to-one, cover a distance with or without the ball and shoot well, and perform all these things at a pace of 80 to 100. Futsal players, therefore, have a good anaerobic capacity (Ocak, Buğdaycı, 2012).

This result is also consistent with the structure of futsal. Therefore, it can be stated that this difference is due to the game structure of futsal. In other words, futsal players have a better anaerobic capacity than football players.

Football players playing on an open field can occasionally find time to rest by jogging and walking after high loads and high-intensity performances.

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Therefore, open field football players perform in a less glycolic environment than do futsal players. Thus, football players are exposed to less lactic acid, and consequently have a lower lactic acid tolerance than futsal players.

Most football activities consist of off-the-ball movements with many aerobic features such as creating free space for the player with the ball, deceiving the opponent and chasing the opponent. Players with the ball perform more anaerobically than aerobically to score. A player in a game uses anaerobic energy sources to sprint in 90 seconds and to engage in high-intensity effort every 30 seconds. Most of the energy needed in a game of football is aerobically obtained (Günay, et al., 2018). This statement also supports our findings.

Futsal and football players had a mean LA level of 7.875 mmol/l and 7.705 mmol/l, respectively, 3 minutes after the Yo-Yo test. However, the post-test mean LA level of futsal players dropped to the level of football players 3 minutes after the test, indicating that futsal players recover faster than football players.

Arend et al., (2015) reported that football players aged 19-27 years had a mean LA level of 11.8 mmol and 10.9 mmol/l three and five minutes after test, respectively. The results of this study show that the athletes in our sample recover faster.

Most of the lactic acid is removed from the body through oxidation. Futsal players use more oxygen, and therefore, their bodies go through more oxidation and remove more lactic acid.

It is reported that a futsal player' heart rate during a game is between 170 and 190 beats/min (Stolen, et al., 2005).

Anaerobic metabolism is, therefore, more dominant in high-intensity movements in a confined space (Buchheit, et al., 2009).

There are many training programs to improve aerobic and anaerobic endurance. Lately, game-based training exercises have been widely used for the development of both technical skills and fitness for team games. Some studies suggest game-style training for both skill and fitness development (Gencay, Çoksevim, 2000; Alvarez, Castagna, 2007; Gabbett, 2008; Parra, et al., 2000).

The most important factors affecting the development of anaerobic performance are increasing metabolic enzyme activities depending on training and cellular regulation which delays fatigue (Harmer, et al., 2000; Edge, et al., 2006).

Many studies emphasize that high intensity training significantly increases muscle buffer capacity and that this increase is related to anaerobic performance (Bogdaniş, et al., 1996).

Most of the energy required for high-intensity loads repeated at specific intervals is provided by anaerobic processes while the rest is provided by aerobic metabolism. Max.VO2 can, therefore, be improved by an increase in aerobic glycolysis and enzyme activities. Previous research reported that high-intensity training significantly increases both anaerobic and aerobic endurance. The results of similar studies addressed above are in parallel with our research findings.

To sum up, football players have a longer running distance than futsal players. Futsal players reach higher LA levels and show more tolerance to lactic acid than do football players at maximal strength testing. In addition, futsal players recover and remove lactic acid from their bodies faster than football players.

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