

The heart rate, blood lactate and oxygen saturation changes of female futsal players during competition

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ABSTRACT

The purpose of this research is to investigate the changes in heart rate, blood lactate and oxygen saturation values of female futsal players during the game. Eleven athletes (Xage: 15,50±0,53 years, Xheight: 162±0,17 cm, Xweight: 57,67±4,11 kg) who are players in a women's futsal team in Denizli participated in the study voluntarily. The players who attended the study performed a match with official rules. Before the game, heart rate and oxygen saturation values of the subjects; heart rate, oxygen saturation and blood lactate values at half time and end of the game were obtained. Heart rate and oxygen saturation values of the subjects were taken from the left hand index finger with the pulse oximeter. Blood lactate values of the subjects were taken from the earlobe with a lactate analyzer at half time and 3 minutes after the end of the game while the subject was sitting. Collection of the blood samples from the ear lobe were made at half-time and 3 minutes after the end of the game. Descriptive analyzes of the test parameters were calculated as mean and standard deviation. Whether the data differed statistically, the normal distribution and homogeneity of the variances were analyzed and analyzed by t-test in dependent groups. There was a significant difference in the heart rate values of the athletes before the game, at half time and after the game ($p < 0.05$). But, there was no statistically significant difference in the oxygen saturation values of the athletes before the game, at half time and after the game ($p > 0.05$).

Keywords: Futsal, women, heart rate, lactate, oxygen saturation

INTRODUCTION

Futsal is a high-intensity indoor sport where short sprints and change of directions alternate with short periods of rest for a rather long time. Futsal is played 5 vs 5 including goalkeeper in an indoor court sized 40 x 20 m. The playing time is 2 x 20 min with a break between the halves, and the clock is stopped when ball is out of play. Therefore, the playing time is 75-85 % longer than 40 min.¹ The amount of substitutions is unlimited, and therefore allows for longer recovery times during the game, when necessary. Futsal requires both good aerobic endurance for recovery during the game breaks, and good repeated sprint ability (RSA) during the game.² VO₂max values between 55-60 ml/kg/min have been measured from professional futsal players (Beato et al. 2016). HR during the game is over 85% of HRmax for 83 % of time, and seldom drops under 150 bpm.¹ Values are higher compared to football, handball or basketball, and highlights the high-intensity nature of professional futsal.

Futsal, an intermittent sport that requires high physical qualities, consists of elements of many sports branches from basketball and handball to hockey.³ Though resembling soccer, futsal has its own character by possessing unique features requiring distinct activity profiles and physiological demands, be it the game rules, number and position of the players, or the pitch size.³ By being a sport requiring a smaller game format with less number of players, and bringing physiological and technical/ tactical stimuli together, small-sided games are more demanding on physiology. As a great deal of studies on small-sided games set forth, this kind of a game format causes alterations on physiological variables such as heart rate, blood lactate and oxygen saturation.⁵⁻⁷ The reduced pitch dimension and recurrent turnovers force athletes to

improve fast decision-making and high sprint capabilities in coping with the pressure during attacking and defending phases is demonstrative of this situation.^{8,9} The effects of physiological parameters in futsal have been examined by some researchers, but there are very few studies about physiological responses during competition in the literature review. The purpose of this research is to investigate the changes in heart rate, blood lactate and oxygen saturation values of female futsal players during the game.

METHODS

Subjects: Eleven athletes (Xage: 15,50±0,53 years, Xheight: 162±0,17 cm, Xweight: 57,67±4,11 kg) who are players in a women's futsal team in Denizli city participated in the study voluntarily. The players who attended the study performed a match with official rules. The players were informed about the aims, method, prospective contributions of the study. Players were also provided with full information about possible risks they may face during the study and signed a consent form. All measurements were taken before the game, at half time and after the game.

Heart Rate, Oxygen Saturation and Blood Lactate: Before the game, heart rate and oxygen saturation values of the subjects; heart rate, oxygen saturation and blood lactate values at half time and end of the game were obtained. Heart rate and oxygen saturation values of the subjects were taken from the left hand index finger with the pulse oximeter. Blood lactate values of the subjects were taken from the earlobe with a lactate analyzer at half time of the game and 3 minutes after the end of the game while the subject was sitting. Collection of the blood samples from the ear lobe were made at half-time and 3 minutes after the end of the game. Accutrend Lactate Portable Lactate Analyzer was used to collect blood lactate

concentration samples. Goalkeepers were not taken into consideration.

Statistical Analyses: The data are presented as means and standard deviations by using SPSS 21 for Windows. After examining whether the data differed statistically or

not, the normal distribution and homogeneity of variances, it was analyzed by analysis of variance in repeated measures and t-test in dependent groups. P-values below 0,05 were considered statistically significant.

RESULTS

Subject' Profile: Players' age, height and body mass, are 15,50±0,53 year, 162±0,17 cm, and 57,67±4,11 kg respectively (Table 1).

Table 1. Profile of subjects

	N	Min.	Max.	Means ± Sd	
Age(year)	11	14	16		15,50±0,53
Height (cm)	11	160	168		162±0,17
Body mass (kg)	11	50	61		57,67±4,11

Table 2. The variance analysis table for repeated measures of heart rate and oxygen saturation of the subjects

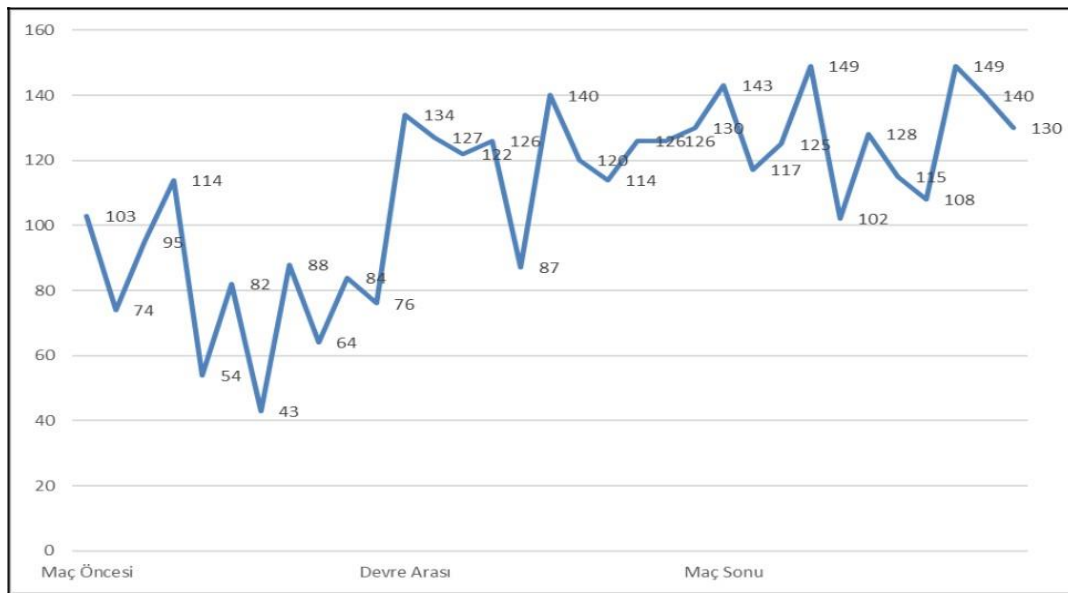
	Measurement	Mean	Sd	F	p
Heart Rate (b.p.m)	Before the game	79,73	20,85	26,07	0,00*
	Half time	134,91	13,74		
	End of the game	143,82	16,22		
Oxygen Saturation(SpO2) (mm Hg)	Before the game	98,91	3,21	0,19	0,83
	Half time	96,45	1,44		
	End of the game	97,18	0,87		

p<0,05

According to table 2, there was a significant difference in the heart rate values of the athletes before the game, half time and after the game (p <0.05). But, there was no statistically significant difference in the oxygen saturation values of the athletes before the game, at half time and after the game (p> 0.05).

Heart Rate: Heart rate values (b.p.m) of female futsal players before the start of the game, at half-time, and after the end of the game are shown in figure 1.

Figure 1. Heart rate graphic



Oxygen Saturation(SpO2): Oxygen saturation values of female futsal players before the start of the game, at half-time, and after the end of the game are shown in figure 2.

Figure 2. Oxygen saturation graphic (mm Hg)

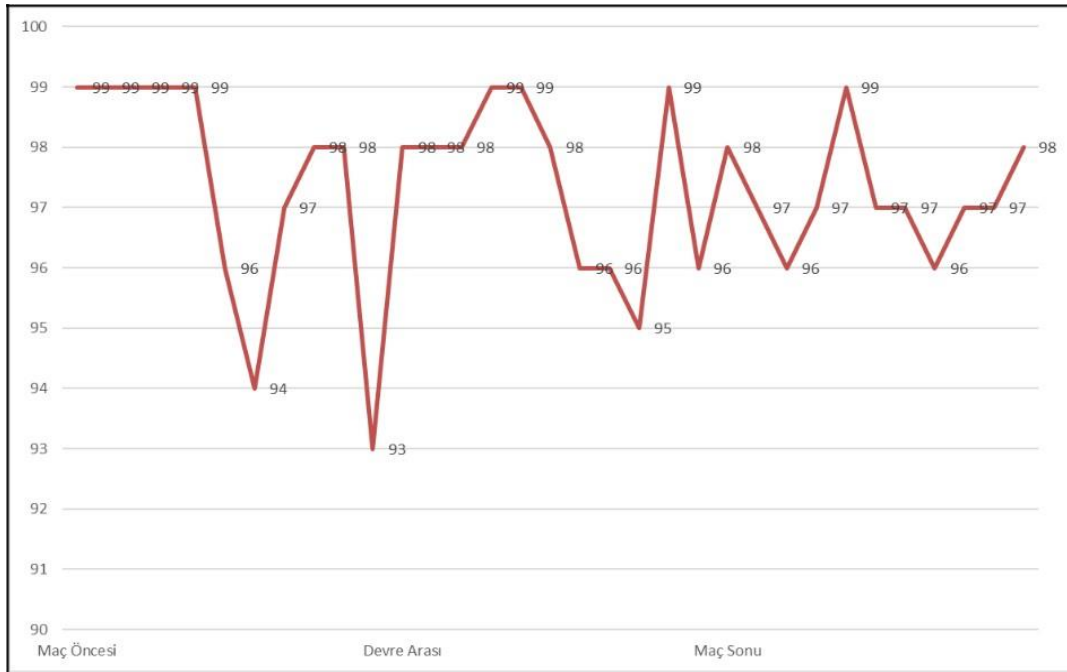


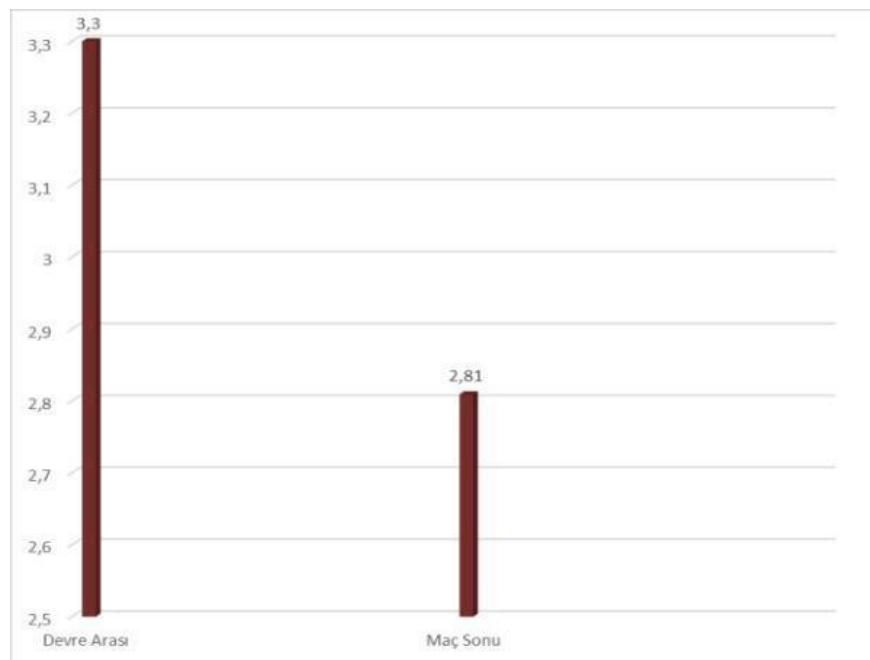
Table 3. Participants' blood lactate values

Measurement	Mean	Sd	2,3	0,04*
Half time	3,37	1,25		
End of the game	2,81	1,33		

According to table 3, a statistically significant difference was found in the blood lactate levels of the athletes between the half time and the end of the game ($p < 0.05$).

Blood Lactate: Blood lactate values of female futsal players before the start of the game, at half-time, and after the end of the game are shown in figure 3.

Figure 3. Blood lactate graphic (mmol/L)



DISCUSSION

The purpose of this research is to investigate the changes in heart rate, blood lactate and oxygen saturation values of female futsal players during the game. Results showed that the average heart rate level was 134,91 beat/min at the half time while the the average heart rate level was 143,82 beat/min at the end of the match. The examination of the lactate levels demonstrated that the lactate level measured before the match that was 1,41 mmol/L, rised to 3,37 mmol/L at the half-time, and to 2,81mmol/L at the end of the game. While oxygen saturation value measured before the game was 99 mm Hg, this value was 93 mm Hg at the half-time and it was 98 mmHg after the game.

Related studies in the literature have demonstrated that futsal is a multiple-sprint sport in which high-intensity exercise constitutes a greater proportion of match time than in all other team sports. The results indicate a greater proportion of time spent above 85% of maximum heart rate (HRmax) with mean values of 90% HRmax per match. Under more specific analysis, only 0.3% of playing time is spent in low activity (below 65% of HRmax), 16% in moderate activity (between 65-85% of HRmax), and 83% in very vigorous activity (above 85% of HRmax) These cardiovascular demands demonstrate the primordial role of the anaerobic metabolism which in most players is above the lactate threshold .¹⁰

In a study conducted by Castagna, et.al.² futsal players spent more than 50% of the playing time at exercise intensities higher than 90% of maximum HR (HRmax) and blood lactate concentration increased after physical stimulation, reaching average values of 5.3 mmol/L. These results suggest that futsal game requires high physical exertion energetically maintained by anaerobic metabolism.

In the study conducted by Pagano et al.¹¹ physiological and hormonal aspects of female futsal players were analyzed. There was no significant difference in the percentages of occurrence of %HRmax and blood LA values during both periods of the futsal games. The lack of difference between the two periods of the game in terms of the HR and blood lactate values of the athletes is explained as a result of the high level of performance of the players throughout the match. When the results of this study are compared to our findings, the heart rate and blood lactate levels obtained in this study were higher than those in our study. This may be because the athletes in both studies were in competition levels as professional and amateur players.

In a study conducted by Makaje et al.¹² physiological data of 30 players of two different competition levels (elite and amateur players) were examined. The values of HR and blood lactate in elite group players were higher than the values of the amateur players (%HRmax: 89.8±5.8 vs. 86.2±6.7, and blood lactate: 5.5±1.4 vs. 5.1±1.5 mmol/L). The lactate levels of both of the groups analyzed in that study were higher than the results in our study.

CONCLUSIONS

Related studies in the literature have demonstrated, the exercise intensity that corresponds to 2 mmol/L lactate concentration is defined as the extensive endurance, 2-3 mmol/L range as intensive endurance, 4-6 mmol/L range as extensive interval and 6-12 mmol/L range as intensive interval.^{4,13} The findings of our study show that the lactate level of the athletes, which was measured as 2.8 mmol at the end of the competition, was equivalent to the intensive endurance training of the athletes, and accordingly, their heart beat, oxygen saturation and blood lactate levels increased. In order to maintain their good performance of futsal athletes for a long time, it is recommended that trainers give importance to intense endurance in training programs.

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